U.S. Department of Transportation
Research and Innovative Technology Administration

SR-018

RITA Bureau of Transportation Statistics

Special Report

September 2009

U.S. Freight on the Move: Highlights from the 2007 Commodity Flow Survey Preliminary Data

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More than 13 billion tons of freight, valued at $11.8 trillion, were transported nearly 3.5 trillion ton-miles[1] in the United States during 2007, according to preliminary estimates from the 2007 Commodity Flow Survey (CFS).[2]

The tonnage, value, and ton-miles of 2007 freight shipments all increased over 2002 totals. Tonnage was up 12 percent, inflation-adjusted value up 13 percent, and ton-miles up 11 percent (see box A).

On a typical day in 2007, over 35.7 million tons of goods, valued at $32.4 billion, moved nearly 9.6 billion ton-miles on the nation's transportation network. Nearly 93 percent of the total tonnage and 81 percent of the total value of freight were shipped by means of a single transportation mode, while the remainder was shipped using two or more modes.

The CFS, a survey of shippers sponsored by the Bureau of Transportation Statistics (BTS) in partnership with the Census Bureau, provides a detailed, multimodal picture of national freight flows. The survey is the only publicly available source of national commodity flow data for the highway mode. CFS data are collected every 5 years as a component of the national Economic Census and provide a benchmark on the value, tonnage, ton-miles, distance shipped, and mode used to transport commodities. Analysis and research utilizing CFS data are used to make decisions in the public and private sectors involving policy, infrastructure, and the economy.

The 2007 CFS data and results presented in this report are preliminary. The 2007 CFS was conducted from a sample of 102,369 establishments. Previous surveys were conducted in 1993, 1997, and 2002. Final CFS data are scheduled for release in December 2009.

[1] A ton-mile is defined as 1 ton of freight transported 1 mile.
[2] Preliminary data tables 1 through 6 from the 2007 Commodity Flow Survey are available online at: http://www.bts.gov/publications/commodity_flow_survey/preliminary_tables_december_2008/index.html

Box A: How to Interpret Shipment Value and Tonnage Data

The value and ton estimates in the Commodity Flow Survey (CFS) represent the sum of multiple shipments of a commodity as it moves through the production and distribution segments of the supply chain. Therefore, CFS totals are much larger than the value added and final weight of materials used in products purchased by consumers and other end users. Also, the total value of shipments, as measured by the CFS, is not directly comparable to the national Gross Domestic Product (GDP), even though both are ostensibly of similar size, because GDP measures the value added or net output of production. The value of goods measured in the CFS includes the market value of goods used in production as well as final demand. Hence, commodities may be counted more than once in the CFS.

How Did Freight Move?

By Truck[3]

Trucking is the largest mode in both value of shipments handled and tonnage. In the 2007 CFS preliminary data, truck shipments accounted for:

- about $8.4 trillion worth of goods, an inflation-adjusted gain of 9.1 percent from 2002, and 71 percent of the total value of all shipments (table 1);
- about 9.0 billion tons of goods, an increase of 14.2 percent from 2002, and 69 percent of all tonnage;

[3] The type of truck shipments under discussion is single mode; that is, the shipments were not transported by any other mode, such as rail, water, or air.

Table 1: U.S. Value, Tonnage, and Ton-Miles of Shipments by Mode of Transport, Percent of Total: 2007

Transportation mode	Value (million $)	Percent of total	Tons (thousands)	Percent of total	Ton–miles (millions)	Percent of total
All modes	11,831,503	100	13,016,610	100	3,490,806	100
Truck	8,363,657	71	8,957,687	69	1,390,102	40
Rail	387,567	3	1,928,530	15	1,294,921	37
Water	106,905	1	423,282	3	175,973	5
Air (includes truck to/from airport)	209,611	2	3,525	–	4,014	–
Pipeline	487,140	4	774,732	6	NA	NA
Parcel, USPS, or courier	1,597,931	13	36,029	–	29,535	1
Multiple modes	340,953	3	590,510	5	460,233	13
Other and unknown modes	337,739	3	302,315	2	47,964	1

NOTES: A percent below 0.5% is marked by a dash (–) in the table. NA = not available due to high sampling variability or poor response quality.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 1, December 2008.

- about 1.4 trillion ton-miles, representing 40 percent of all ton-miles; and
- an average distance of 187 miles per shipment (see box B).

The CFS distinguishes between two categories of truck: for-hire[4] and private.[5] Both experienced significant growth over the 2002 CFS totals. Private truck tonnage increased by 18.8 percent to 4.9 billion tons, while for-hire truck tonnage grew 10.2 percent to 4.0 billion tons. Private trucks handled more than half the tonnage, while for-hire trucks carried over half the value (table 2). Historically in the CFS, goods with the largest total tonnage moved primarily by truck include gravel and crushed stone, gasoline, natural sands, fuel oils, and most mixed freight.

Table 2: Value and Tonnage of U.S. Highway Shipments: 2007

Highway transportation mode	Value (million $)	Percent of total	Tons (thousands)	Percent of total
Highway total[1]	8,363,657	100	8,957,687	100
For-hire truck	4,764,442	57	4,029,016	45
Private truck	3,599,215	43	4,928,671	55

[1] Highway shipments are single-mode shipments not transported by any other mode.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 1, December 2008.

Goods moved by private truck typically travel much shorter distances than goods carried by for-hire trucks. The average miles per shipment by private truck in the 2007 CFS was 82 miles, compared to 527 miles by for-hire truck.

[4] For-hire means that the truck was operated on behalf of – or by – a nongovernmental business entity that provides transport services to its customers for compensation.

[5] Private means that the truck is not available to any other business entity, nor the public, and is owned and/or operated by an individual, group, or nongovernmental business entity for its own purposes or benefits.

Box B: Mileage Calculation for the Commodity Flow Survey

A critical measurement, calculated from the CFS data, is the mileage traveled by each shipment, used in estimating modal ton-miles of freight. BTS developed an innovative software tool, called GeoMiler,[1] to calculate the distance traveled by mode from origin to destination of any given shipment for which valid and consistent information was provided by the CFS respondent. If for any reason modal mileage calculations are not obtainable for a given shipment, GeoMiler sets pre-arranged codes that explain the problem(s) for possible correction. This new tool for distance estimation uses Geographic Information System (GIS) technology and a robust spatial data network to create a unique and effective routing tool.

[1] A detailed explanation of the development of GeoMiler may be found in BTS Technical Report TR – 001, *How Freight Moves: Estimating Mileage and Routes Using an Innovative GIS Tool*, June 2007, authored by Stephen M. Lewis and Felix Ammah-Tagoe.

By Rail[6]

In the 2007 CFS, rail shipments accounted for:

- nearly $388 billion worth of goods (compared to an inflation-adjusted value of $412 billion in 2002), about 3 percent of the total value of shipments by all modes (table 1);
- over 1.9 billion tons of goods (matched the same weight in 2002), about 15 percent of the total tonnage;
- about 1.3 trillion ton-miles, rail carried 37 percent of all ton-miles—the 1.3 trillion ton-miles moved by rail, when combined with the 1.4 trillion ton-miles by truck, resulted in 77 percent of the total U.S. ton-miles (table 1); and

[6] The type of rail shipments under discussion is single mode; that is, the shipments were not transported by any other mode, such as truck, water, or air.

- an average distance of 691 miles per shipment, showing that rail is generally a long-haul mode.

Historically in the CFS, rail moves bulk shipments such as cereal grains, coal, and metallic ores.

By Water[7]

Whether via inland river, ocean, or the Great Lakes, waterborne shipments in the 2007 CFS preliminary data accounted for:

- about $107 billion worth of goods (table 1), 1 percent of the total value of all shipments;
- approximately 423 million tons of goods, 3 percent of all tonnage;
- about 176 billion ton-miles, 5 percent of all ton-miles; and
- an average distance of 330 miles per shipment.

The Mississippi River system is the most active waterway system in the country for freight transport,[8] and shallow draft vessels, most of which travel the Mississippi River, carried the largest portion of waterborne freight in the United States (table 3).

Table 3: Value and Tonnage of U.S. Waterborne Shipments: 2007

Waterborne transportation mode	Value (million $)	Percent of total	Tons (thousands)	Percent of total
Waterway total[1]	106,905	100	423,282	100
Shallow draft	95,421	89	381,566	90
Great Lakes	705	1	13,261	3
Deep draft	10,779	10	28,455	7

[1] Waterborne shipments are single-mode shipments not transported by any other mode. There are three basic types of vessels shown in the Commodity Flow Survey: shallow draft vessels that ply the Mississippi River, deep draft vessels that move mostly along the coasts, and a separate category of Great Lakes vessels.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 1, December 2008.

Bulk, low-value commodities were primarily transported by rail and water modes. In 2007, water shipments were valued on average at $253 per ton, compared to $201 per ton for rail (table 4), the two lowest modal values per ton in the 2007 CFS. Historically in the CFS, the major commodity groups shipped in bulk via waterway are metallic ores and concentrates, bituminous coal, fertilizers, gravel and crushed stone, and natural sands.

[7] The type of water shipments under discussion is single mode; that is, the shipments were not transported by any other mode, such as truck, rail, or air. Estimates in 2007 are not comparable to those in 2002 because waterborne mileages in the 2007 CFS were calculated using a different methodology.

[8] U.S. Army Corps of Engineers, Navigation Data Center, The U.S. Waterway System - Transportation Facts, December 2008.

By Other Modes

Demand continued to increase for time-specific deliveries of high-value products. The two modes noted for promoting quick delivery were air and parcel. The value of air and parcel shipments in 2007 totaled $1.81 trillion, an increase of 31.3 percent over the 2002 inflation-adjusted value of $1.38 trillion.

Historically in the CFS, the commodity groups shipped by air and parcel are generally considered to be high-value and low-weight: electronic and other electrical equipment, precision instruments, and pharmaceutical products.

At the high-value end, shipments by air (including truck drayage to/from the airport) were valued on average at $59,464 per ton, and the value of parcel shipments averaged $44,351 per ton (table 4).

Table 4: Value per Ton of U.S. Freight Shipments by Transportation Mode: 2007

Transportation mode	Value (million $)	Tons (thousands)	Value per ton[1] (current dollar/ton)
All modes (includes multiple modes)	11,831,503	13,016,610	$909
Single mode	9,554,880	12,087,756	$790
Truck	8,363,657	8,957,687	$934
Rail	387,567	1,928,530	$201
Water	106,905	423,282	$253
Air (includes truck and air)	209,611	3,525	$59,464
Pipeline	487,140	774,732	$629
Parcel, USPS, or courier	1,597,931	36,029	$44,351

[1] Value per ton is defined as the average worth in current dollars of one ton of freight. This measure is computed by dividing the total value by the tons of freight originated.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 1, December 2008.

Which Industries Were Shipping Goods?

Data by industry are being published for the first time in the 2007 Commodity Flow Survey. Shipments by manufacturing industries accounted for 45 percent of the value (table 5) and 41 percent of the commodity weight. Shipments by wholesalers accounted for 41 percent of the value and 30 percent of the weight captured by the 2007 CFS. Auxiliary establishments[9] shipped nearly $1.28 trillion of freight, about 11 percent of the U.S. total value.

[9] Auxiliary establishments are those specifically involved in warehousing and storage, or as corporate, subsidiary, and regional managing offices.

Table 5: U.S. Value and Tonnage of Shipments by Industry, Percent of Total: 2007

Industry	Value (million $)	Percent of total	Tons (thousands)	Percent of total
All industries	11,831,503	100	13,016,610	100
Mining (except Oil and Gas)	65,079	1	3,119,289	24
Manufacturing	5,384,430	45	5,384,427	41
Wholesale trade	4,806,561	41	3,963,397	30
Auxiliary industries	1,275,360	11	470,821	4
Other industries	300,073	2	78,676	1

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 5, December 2008.

Table 6: Value by Two-Digit Commodity: 2007

SCTG code[1]	Commodity description	Value[2] (million $)
	All commodities	11,831,503
35	Electronic and other electrical equipment	1,040,585
43	Mixed freight	974,634
36	Motorized and other vehicles (including parts)	828,359
17	Gasoline and aviation turbine fuel	793,713
21	Pharmaceutical products	778,370
34	Machinery	631,390
40	Miscellaneous manufactured products	507,717
07	Other prepared foodstuffs and fats and oils	489,767
24	Plastics and rubber	488,100
32	Base metal in primary or semifinished forms	479,557
30	Textiles, leather, and articles of textiles or leather	466,156
18	Fuel oils	402,578
33	Articles of base metal	380,789
23	Chemical products and preparations, NEC[3]	344,096
19	Coal and petroleum products, NEC[3]	298,433

[1] Based on 2-digit code for Standard Classification of Transported Goods (SCTG).
[2] Horizontal lines and color codes are used within the table to group the commodities. Commodities within the same group, or the same color code, cannot be determined to be different statistically from one another. However, from top to bottom, a change in grouping, or a change in color, denotes a statistical decrease in level of value, based on statistical significance testing at the 95% confidence level.
[3] NEC = not elsewhere classified.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 6, December 2008.

What Goods[10] Were Being Shipped?

By value, electronic and other electrical equipment and mixed freight[11] were the leading commodity groups, at $1 trillion and $974.6 billion (table 6), respectively (see box C).

These two commodity groups accounted for 17 percent of the total value of goods transported. Other leading commodity groups by value were motorized and other vehicles, gasoline and aviation turbine fuel, and pharmaceutical products, all of which totaled about $2.4 trillion or 20.3 percent of the total value of goods.

By weight, the leading commodity group was gravel and crushed stone, accounting for nearly 1.9 billion tons or about 14.5 percent of the total tons in the 2007 CFS (table 7). Gravel and crushed stone were moved mainly short distances with an average of 39 miles per shipment and a relatively low bulk value of $10 per ton.

[10] Commodity goods in the CFS are classified by Standard Classification of Transported Goods (SCTG) codes. Developed as a joint effort of the United States and Canada, the SCTG is a hierarchical system that groups commodities by transportation characteristics (volume, revenue, value, origin, and destination), similarities of goods, and industry-of-origin considerations, regardless of mode(s) of transport.
[11] Mixed freight includes items (food also) for grocery and convenience stores, supplies and food for restaurants and fast-food chains, hardware or plumbing supplies, and office supplies.

Table 7: Tonnage by Two-Digit Commodity: 2007

SCTG code[1]	Commodity description	Tons[2] (thousands)
	All commodities	13,016,610
12	Gravel and crushed stone	1,885,219
15	Nonagglomerated bituminous coal	1,234,583
31	Nonmetallic mineral products	1,182,580
17	Gasoline and aviation turbine fuel	1,135,395
19	Coal and petroleum products, NEC[3]	847,597
18	Fuel oils	692,777
02	Cereal grains	672,952
11	Natural sands	484,498
07	Other prepared foodstuffs and fats and oils	461,975
26	Wood products	413,844
20	Basic chemicals	408,198
32	Base metal in primary or semifinished forms	397,286
43	Mixed freight	313,129
03	Other agricultural products	271,460
13	Nonmetallic minerals, NEC[3]	257,185

[1] Based on 2-digit code for Standard Classification of Transported Goods (SCTG).
[2] Horizontal lines and color codes are used within the table to group the commodities. Commodities within the same group, or the same color code, cannot be determined to be different statistically from one another. However, from top to bottom, a change in grouping, or a change in color, denotes a statistical decrease in level of tonnage, based on statistical significance testing at the 95 % confidence level.
[3] NEC = not elsewhere classified.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, Preliminary Data Table 6, December 2008.

Box C: How to Interpret Shipment Value and Tonnage Data for Mixed Freight (SCTG 43)

Mixed freight[1] (SCTG 43) is among the leading commodity groups by both value and weight of shipments. However, the growth in mixed freight is attributable in large measure to the manner in which goods are shipped and identified, plus ongoing changes in the transportation industry.

Generally, distribution centers are more likely to ship goods generically referred to as "mixed freight." A growing number of shippers send their goods under rates for "freight all kinds" (FAK). Hence, shipments from distribution centers are often identified simply as mixed freight, rather than a specific product classification.

[1] Mixed freight includes items (food also) for grocery and convenience stores, supplies and food for restaurants and fast-food chains, hardware or plumbing supplies, and office supplies.

In 2007, other leading commodity groups by weight included coal, nonmetallic minerals, and gasoline. Mixed freight was another commodity group with substantial tonnage—313 million tons (see box C).

Among the commodity groups, coal generated the most ton-miles (table 8). A total of 1.2 billion tons of coal was moved 722 billion ton-miles, which was 20.7 percent of the total ton-miles recorded in the 2007 CFS. The primary U.S. coal deposits are found in the Powder River basin of Wyoming and in the states of Kentucky, West Virginia, and Pennsylvania.[12] Movements of coal averaged 115 miles per shipment. Texas received the most out-of-state coal shipments, while Canada and Brazil were the largest foreign destinations for U.S.-produced coal.[13]

[12] Goode's World Atlas, 21st Edition, published by Rand McNally & Co., June 2006.
[13] U.S. Department of Energy, Energy Information Administration, U.S. domestic coal consumption by state: 2007 available at: http://www.eia.doe.gov/cneaf/coal/page/acr/table26.html
U.S. coal exports by country: 2007 available at: http://www.eia.doe.gov/fuelcoal.html

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Table 8: Ton-Miles by Two-Digit Commodity: 2007

SCTG code[1]	Commodity description	Ton-miles[2] (millions)
	All commodities	3,490,806
15	Nonagglomerated bituminous coal	722,280
02	Cereal grains	280,363
19	Coal and petroleum products, NEC[3]	206,377
07	Other prepared foodstuffs and fats and oils	159,873
32	Base metal in primary or semifinished forms	148,620
20	Basic chemicals	148,281
26	Wood products	134,137
12	Gravel and crushed stone	132,653
17	Gasoline and aviation turbine fuel	129,911
31	Nonmetallic mineral products	123,301
03	Other agricultural products	121,512
24	Plastics and rubber	102,718
27	Pulp, newsprint, paper, and paperboard	80,369
04	Animal feed and products of animal origin, NEC[3]	70,558
18	Fuel oils	65,627

[1] Based on 2-digit code for Standard Classification of Transported Goods (SCTG).
[2] Horizontal lines and color codes are used within the table to group the commodities. Commodities within the same group, or the same color code, cannot be determined to be different statistically from one another. However, from top to bottom, a change in grouping, or a change in color, denotes a statistical decrease in level of ton-miles, based on statistical significance testing at the 95% confidence level.
[3] NEC = not elsewhere classified.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, 2007 Commodity Flow Survey, preliminary data table 6, December 2008.

About This Report

This article was a collaborative effort on the part of the following from the Bureau of Transportation Statistics (BTS): Michael Margreta, Survey Statistician; Chester Ford, Transportation Industry Analyst; and M. Adhi Dipo, Transportation Analyst under contract from MacroSys Research and Technology. Promod Chandhok (BTS) provided assistance in statistical significance testing. BTS is a component of DOT's Research and Innovative Technology Administration. Other BTS contributors include: Ronald Duych, Joy Sharp, and Hossain Sanjani.

Throughout this report, comparisons are made between two different entities (numbers, groups, classifications, categories, etc. developed from a sample), and an increase or decrease is cited as a percentage change or statistical difference. Such a change is only given if statistically significant at the 5 percent level, which indicates there is a 5 percent chance that a statistically significant difference will be claimed between two different entities from the sample when, in fact, no such difference truly exists in the entire population.

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