

Bureau of Transportation Statistics Special Report

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Sitting on the Runway: Current Aircraft Taxi Times Now Exceed Pre-9/11 Experience

by Bruce Goldberg and David Chesser

Several high profile incidents have focused attention on "tarmac delays" that resulted in air travelers spending long periods of time aboard aircraft waiting to either take off or move to a gate after landing. Taxi-time data collected by the Bureau of Transportation Statistics (BTS) for the year 2007 shows:

- Both outbound and inbound taxi times increased noticeably in 2007 and surpassed the previous peak reached in 2000.
- 93 percent of flights left the ground within 30 minutes of gate departure, compared to 96 percent in 1995.
- Extended taxi times in excess of 2 hours, which occur infrequently, increased in recent years but have not reached the levels experienced in the 1999 to 2000 period.
- The longest taxi-out times occurred during the summer.

- Although flight volumes impact taxiing times, other factors also come into play.

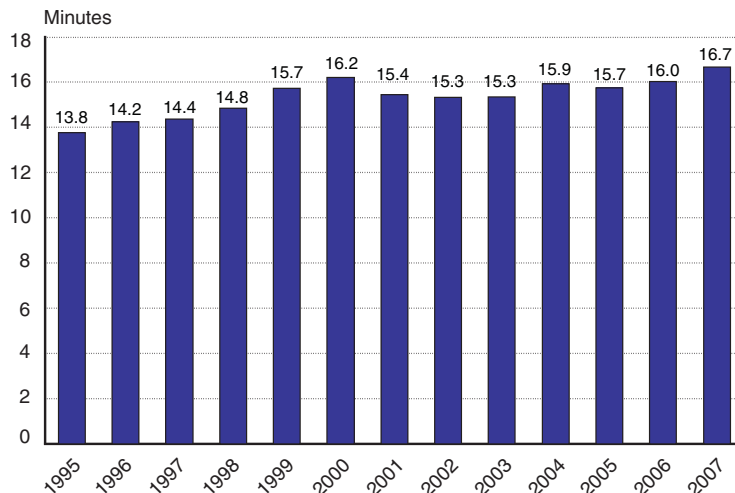
Taxi-Time Data

Any carrier that accounts for at least 1 percent of annual domestic scheduled-service passenger revenue is required to report taxi-time data. In 2007, 18 carriers met this requirement and these carriers, plus two that voluntarily submitted taxi-time data, accounted for about 70 percent of all scheduled-service departures while servicing about 90 percent of all domestic passengers.

Taxi-Out Times

The average time spent on the ground by these flights after leaving the gate (taxi-out time) increased from 13.8 minutes in 1995 to 16.7 minutes in 2007, an increase of 21 percent.

Figure 1: Average Taxi-Out Times by Year



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

The increase in taxi-out times has not been steady over the period. Between 1997 and 2000, taxi-out time increased from 14.4 to 16.2 minutes. However, after the September 11, 2001 terrorist attacks and subsequent reduction in the number of total flights, taxi-out time dropped to an average of 15.3 minutes in 2002 and 2003. Taxi-out time then increased in 2004, before declining again in 2005. In 2007, the average taxi-out time surpassed the previous 2000 high. Figure 1 shows the changes in the taxi-out time since 1995.¹

Most flights are off the ground within 30 minutes of leaving the gate. However, the incidence of longer taxi times has

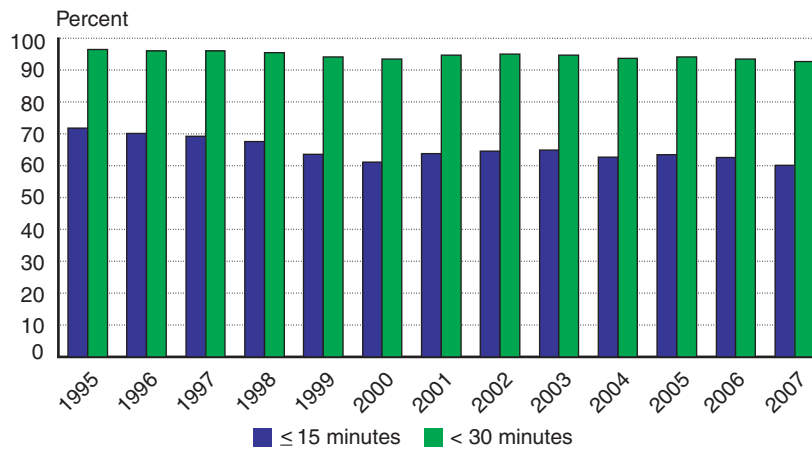
¹ The taxi-out and taxi-in calculations for this report exclude any flight for which the taxi-in or taxi-out is reported as zero minutes. Reporting errors that result in taxi times of greater than 24 hours have been adjusted. Taxi-out and taxi-in data for Comair in 2004 are not included due to data errors that could not be resolved. See box B.

increased over the years. In 1995, 72 percent of flights were off the ground in 15 minutes, and 96 percent within 30 minutes. By 2007 these percentages had dropped to 60 percent leaving the ground within 15 minutes of leaving the gate, and 93 percent taking off within 30 minutes. The annual percentage of flights getting off the ground within 15 and 30 minutes are shown in figure 2.

Taxi-In Times

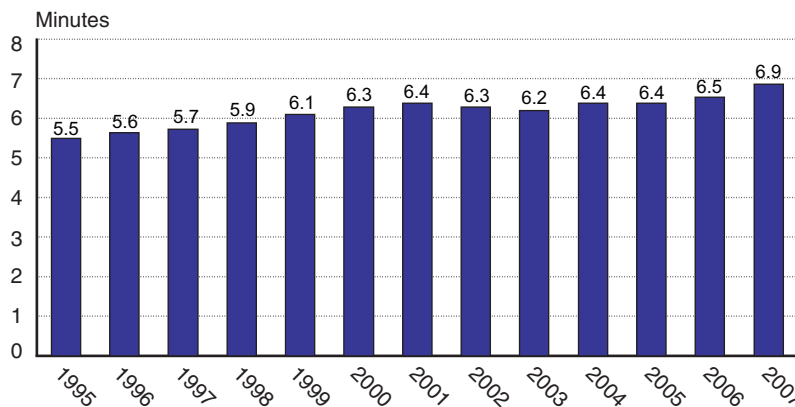
Average time spent getting to the gate after touching down has also lengthened over the years, from an average of 5.5 minutes in 1995 to 6.9 minutes in 2007—an increase of 25 percent. After increasing steadily through 2001, taxi-in times leveled off to between 6.2 and 6.4 minutes in the 2002 to 2005 period. Taxi-in times again began to rise in 2006, peaking at 6.9 minutes in 2007. Figure 3 shows changes in the average taxi-in times since 1995.

Figure 2: Percent of Departures with Taxi-Out Times Less Than 30 Minutes and of 15 Minutes or Less



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Figure 3: Average Taxi-In Times by Year



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Taxi Times Increase in 2007

Taxi times for both departing and arriving flights increased noticeably in all but 3 months of 2007 relative to the same month in 2006. See table 1. The longest 2007 taxi times occurred during the summer peak months and in December. Taxi-out times exceeded 17 minutes in each peak month and reached a high of 17.5 minutes in December. Taxi-in times exceeded 7 minutes in the summer months and reached a high of 7.2 minutes in December. An exception to the increases in taxi times between 2006 and 2007 were relatively small decreases in taxi-out times for September, October, and November.

Table 1: Average Taxi Times by Minutes for 2007 v. 2006

	Taxi-out			Taxi-in		
	2006	2007	Percent change	2006	2007	Percent change
January	15.1	16.8	10.7%	6.4	6.7	5.8%
February	15.4	16.7	8.9%	6.4	6.9	8.1%
March	15.7	16.3	3.8%	6.4	6.7	4.8%
April	15.4	16.1	4.3%	6.2	6.6	5.5%
May	15.6	16.2	3.8%	6.3	6.7	6.1%
June	16.4	17.3	5.8%	6.6	7.1	6.8%
July	16.4	17.1	4.1%	6.8	7.1	4.7%
August	16.4	17.1	4.1%	6.7	7.1	5.4%
September	16.5	16.1	-1.9%	6.6	6.8	2.2%
October	16.6	16.5	-0.4%	6.6	6.8	2.5%
November	16.4	16.2	-1.2%	6.6	6.7	1.9%
December	16.3	17.5	7.5%	6.8	7.2	6.4%
Annual (minutes)	16.0	16.7	4.0%	6.5	6.9	5.0%

NOTE: Percent change is based on unrounded average minutes.

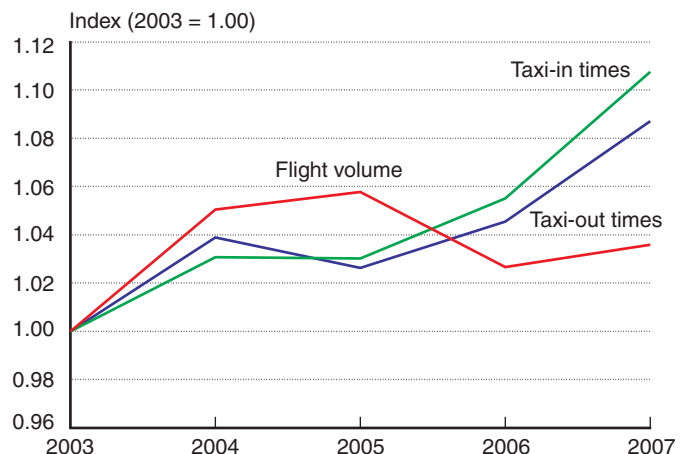
SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Flight Volume and Taxi Times

Over the long term, taxi times have increased along with the number of flights. However, in the short term, changes in taxi times do not always mirror a change in flight volume. Starting in 2003, the first full year during which all certificated carriers were required to report traffic data, the number of flights increased over the next 2 years.² Taxi times increased with flight volume in 2004, but then taxi-out times decreased in 2005 while taxi-in times were about the same. During 2006 the number of flights declined, but taxi times increased. In 2007 taxi times increased at a greater rate than the increase in flight volumes. See figure 4. This suggests that factors other than flight volume also affect the time planes spend on the ground.

² Since October 2002, all certificated carriers have been required to report in the T-100 database all departures operated. Therefore, the first full year for which the total number of airline flights systemwide is available is 2003.

Figure 4: Changes in Flights and Taxi Times (Indexed to 2003)



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database for taxi times, and T100 Segment Data for number of flights.

Airports and Taxi Times

The airports with the longest average taxi-out and taxi-in times are predominantly high-volume airports. Most are airports that serve as focal points for airline hub-and-spoke networks that tend to concentrate landings and departures during a compressed time period. For 2007, the longest ground times waiting for takeoff occurred at the three New York airports, JFK International, Newark, and LaGuardia, with average taxi-out times of 37, 30, and 29 minutes, respectively. Taxi-in times exceeded 10 minutes at JFK, Atlanta, Detroit, and Dallas-Fort Worth. The longest average taxi times by airport are shown in tables 2 and 3.

Nantucket had an average taxi-out time of 19.8 minutes, but is not shown in table 2 because service at the airport is provided seasonally with an average of only two flights per day. However, this is an example of the ripple effects from larger airports on taxi-out times at smaller airports, as flights at Nantucket destined for Newark were often held on the ground due to conditions at the destination.

Ground Time by Hub Size

Analysis of data for the year 2007, shows that at smaller airports with decreased traffic volume, taxi times are generally shorter. Airports are classified as being located in large, medium, small, or nonhub cities depending on passenger volumes.³ Table 4 shows, for the year 2007, taxi times by hub size.

³ Airports in a geographic area that generate 1 percent or more of the annual domestic enplanements (boardings) are classified as large hubs; 0.25 percent as medium hubs; 0.05 percent as small hubs, and less than 0.05 percent as nonhubs. This definition of hub should not be confused with airline usage of the term to describe "hub and spoke" route structures or other definitions of hubs as used by the Federal Aviation Administration in regard to individual airports.

Taxi-Out Patterns

In addition to airport size, BTS also examined taxi-out times by month, by day of week, and by time of day. For the years 1995 to 2007, June, July, and August had the longest taxi-out times, and the spring and autumn months experienced the shortest. See figure 5.

BTS compared flight volume and taxi-out times to see if the observed seasonal change in taxi-out time is solely related to seasonal variation in the number of flights, rather than other factors. For each month, the average number of daily flights was indexed to the overall average for the 5-year period of 31,207 flights per day, and average taxi-out times were indexed to the 15.95 minute monthly average for the same 5-year period.

Table 2: Ten Longest Average Taxi-Out Times by Airport in 2007

Airport	Average taxi-out time
1 New York, JFK, NY	37.1
2 Newark, NJ	29.6
3 New York, La Guardia, NY	29.0
4 Philadelphia, PA	25.5
5 Detroit, Metro Wayne County, MI	20.8
6 Boston, Logan, MA	20.6
7 Houston, George Bush, TX	20.4
8 Minneapolis-St. Paul, MN	20.3
9 Atlanta, Hartsfield-Jackson, GA	19.9
10 Washington, Dulles, DC	19.7

NOTE: Average taxi out time at Nantucket, MA was 19.8 minutes for 2007. However, service was provided only seasonally with an average of only two departures per day, and thus it is not included in this table.

SOURCES: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Table 3: Ten Longest Average Taxi-In Times by Airport in 2007

Airport	Average taxi-in Time
1 Detroit, Metro Wayne County, MI	10.9
2 New York, JFK, NY	10.8
3 Atlanta, Hartsfield-Jackson, GA	10.7
4 Dallas-Fort Worth, TX	10.5
5 Indianapolis, IN	9.6
6 Newark, NJ	9.5
7 Los Angeles, CA	9.2
8 Houston, George Bush, TX	9.1
9 Minneapolis-St. Paul, MN	8.7
10 Chicago, O'Hare, IL	8.7

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

A comparison of the indexes shows a strong relationship during the summer between increased flight volume and increased taxi-out times. However, from January to April, the taxi-out time index declined when the flight volume index did not. From October to December, the taxi-out time index increased when the departures index fell. This may suggest the impact of weather conditions on taxi-out times. During the winter, severe weather is more likely to adversely impact the national air system, and planes are more likely to spend time on the taxiway being de-iced; therefore, winter taxi-out times may lengthen despite lower traffic volumes. See figure 6.

The average taxi-out time varies by day of week and generally reflects the number of flights. Wednesday through Friday

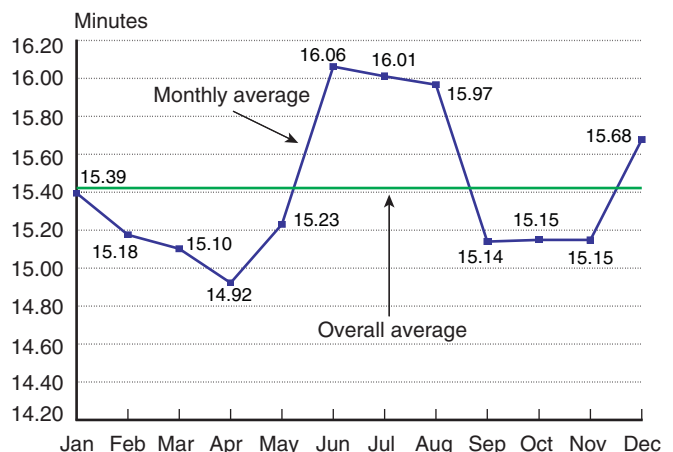
Table 4: Average Taxi Times (minutes) by Hub Size in 2007

	Average minutes		% of Total Operations
	Taxi-Out	Taxi-In	
Large Hub	18.5	7.8	58.8
Medium Hub	13.4	5.3	18.1
Small Hub	12.7	4.7	9.8
Non-Hub	<u>12.0</u>	<u>4.3</u>	<u>13.3</u>
Total	16.7	6.9	100.0

NOTES: Taxi-out (taxi-in) times are based on the departures from (arrivals at) airports with the given hub size. Operations include both departures and arrivals and are based on T100 Segment data.

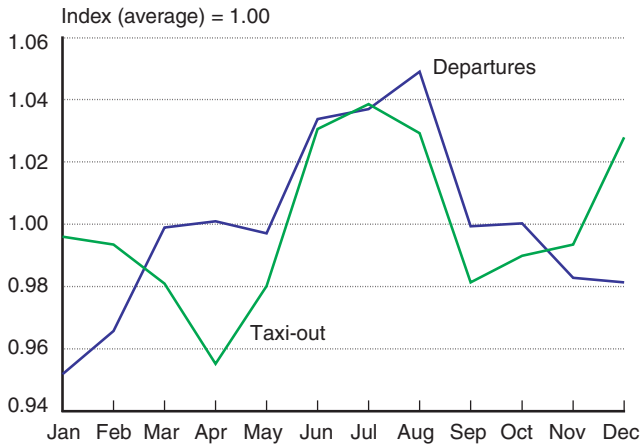
SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database and T100 Domestic and International Segment Databases.

Figure 5: Average Taxi-Out Time by Month Based on 1995 to 2007 Data



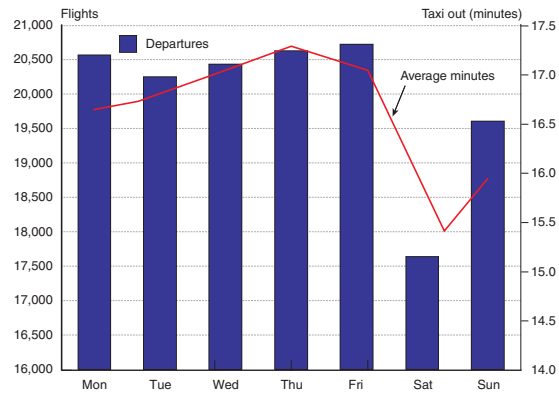
SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Figure 6: Monthly Variation in Daily Departures and Taxi-Out Times (Indexed to 2003-2007 average)



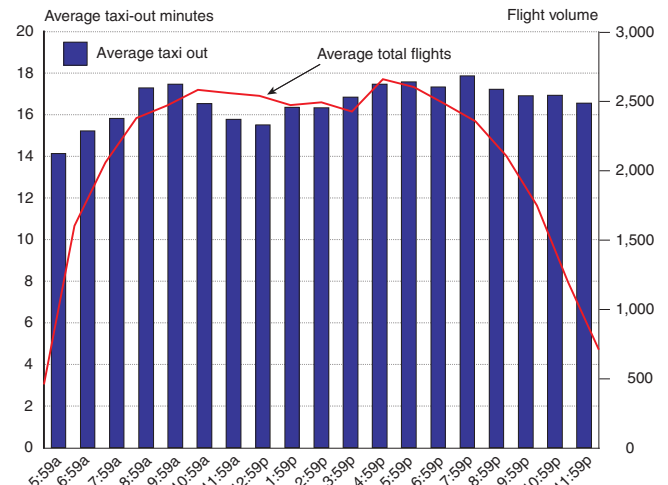
SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Figure 7: Average Taxi-Out Time and Departures by Day of Week in 2007



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Figure 8: Average Taxi-Out Time and Flight Volume by Time of Day in 2007



SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

have the longest average taxi-out times, and are among the busiest days in regard to number of flights.⁴ Saturday, which has the lowest number of flights, has the shortest taxi-out times. Figure 7 shows the relationship between the volume of flights per day of week and average taxi-out times.

The average outbound taxi time varies throughout the day. The longest taxi-out times occur during the 8 to 10 a.m. and 4 to 9 p.m. hours, local time, while the shortest taxi-outs are during the overnight hours when the number of flights is minimal. Although taxi-out times and the number of flights⁵ move in concert, evening taxi times drop only slightly despite a large decline in the number of flights. This is due primarily to departures being concentrated at only a few airports during the late evening hours. During the 10 to 11 p.m. period, Atlanta, Las Vegas, Los Angeles, and San Francisco account for 48 percent of the system total. During the 11 p.m. to midnight hour, the three west coast airports account for just over 50 percent of the system total. So even though the number of flights for the system is down significantly during those late hours, the concentration of departures at a few airports results in volumes typical of the peak periods. As a result, there is not a significant drop in average taxi-out time.

Figure 8 shows the average taxi-out time and the number of flights throughout the day.

Extended Taxi Times

The number of aircraft spending more than 2 hours on the ground before taking off is very small. In 1995, an average of

⁴ Monday has a slightly higher number of departures than Wednesday, although taxi-out times on Monday are lower than on other weekdays.

⁵ The number of flights is generally measured in this paper as one-half the sum of departures and arrivals. In general, this distinction is trivial, but for time of day the distinction is relevant as departures are greater early in the day and arrivals are greater late in the day.

six flights per day spent more than 2 hours waiting to take off after leaving the gate. In 2006, an average of 19 departures per day were on the ground for that long. As a percentage of total operations, these flights represented 0.1 percent of all departures. Year-to-year comparisons of 2-hour plus taxi-outs are shown in table 5.

Flights that spent many hours on the ground but never took off, such as those involved in the well-publicized February 14, 2007, incident at JFK in New York, are not reflected in the taxi-time data. Also, arrival information is not reported for diverted flights, so taxi-in time for these flights also is not included in the data here.⁶ See box A.

The number of long taxi-outs increased between 2006 and 2007. In 2007, 92.5 percent of flights got off the ground

⁶ The taxi-out data for flights diverted en route is collected and included in the database.

Table 5: Number of Flights with Taxi-Out Times in Excess of Two Hours

Year	121-180 minutes	181-240 minutes	241-300 minutes	301+ minutes	2 hour plus taxi-out	Departures with taxi-out time data	% over two hours	
							Percent	Rank
1995	1,786	325	70	33	2,214	5,235,530	0.04%	1
1996	3,131	490	115	18	3,754	5,223,447	0.07%	3
1997	2,467	521	132	79	3,199	5,314,080	0.06%	2
1998	3,712	717	141	16	4,586	5,240,212	0.09%	7
1999	5,219	1,050	246	34	6,549	5,373,573	0.12%	12
2000	5,632	1,241	297	79	7,249	5,495,557	0.13%	13
2001	3,682	623	113	15	4,433	5,736,582	0.08%	4
2002	3,492	712	134	84	4,422	5,206,216	0.08%	5
2003	4,357	858	218	96	5,529	6,386,299	0.09%	6
2004	6,016	1,012	172	42	7,242	6,641,160	0.11%	10
2005	5,695	881	139	27	6,742	7,006,016	0.10%	8
2006	6,110	1,071	188	36	7,405	7,018,147	0.11%	9
2007	7,249	1,327	234	44	8,854	7,291,752	0.12%	11
Grand total	58,548	10,828	2,199	603	72,178	77,168,571	0.09%	

NOTES: Data for flights showing zero taxi-out time were considered to be erroneous and were not included in calculations for this table. Data for Comair for 2004 was not included due to taxi-out time errors for which an appropriate correction could not be determined. The number of departures shown are those for which taxi-out data is available. These numbers do not represent all scheduled airline departures in the year shown.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Box A: Reporting of Canceled and Diverted Flights

- Flights that do not operate, or that leave the gate, spend time on the tarmac, return to the gate, and do not take off are considered canceled flights. Airlines are not required to report taxi time data for canceled flights
- Arrival information is not reported for diverted flights, so taxi-in time for those flights is not included in the BTS data.

within 30 minutes, compared to 93.4 percent one year earlier. The number of 2-hour plus taxi-outs has increased by 20 percent, and they now account for 0.12 percent of all departures. Taxi-outs of 15 minutes or less have declined from 63 percent of departures the previous year, to 60 percent of departures in 2007. A detailed comparison for this period is shown in table 6.

Taxi-out times of 3 hours or more are a very infrequent occurrence, but in a few cases planes have waited on the tarmac for over 5 hours before takeoff. During 2007, there were a total of 44 individual flights that spent over 5 hours on the ground before lifting off. During 2005 through 2007, over half of the flights with taxi-out times in excess of 5 hours were departing from JFK, LaGuardia, or Newark Airports in the New York-New Jersey Metropolitan Area. During that period, there were 107 such flights departing from a total of 23 different airports. Three particular instances accounted for 28 of the 107 flights. On February 14, 2007, 10 flights at JFK, Newark, and Philadelphia spent over 5

hours on the ground during a snow and ice storm before taking off. The delays at JFK received considerable national media attention. On July 27, 2006, when storms stretched from the Midwest through the Ohio Valley, 10 flights at JFK, Newark, and Chicago O'Hare were similarly affected. On June 1, 2006, a front stretching from Maine to Texas brought storms that kept 9 flights on the ground over 5 hours at JFK and LaGuardia, in the northeast, and Fort Myers, Florida (en route to JFK). Five of the six delays at Sun Valley occurred the same day, on February, 25, 2005. The distribution by airport for the 5-hour plus taxi-outs during the 3-year period is shown in figure 9.

Taxi-Out Time and Delays

Increased taxi times do not necessarily mean increased flight delays. When airlines plan flight schedules, they take into account the normal taxi times experienced by flights at the airports being serviced, including allowances for normal operational changes due to seasonal weather impacts. Therefore, the schedule of a flight serving a hub airport will generally reflect the longer taxi-out or taxi-in times experienced at that airport compared to smaller airports. Thus, even if a flight leaving Newark, for example, spends 30 minutes on the ground after leaving the gate, it may arrive at its destination on time. Despite the customer perception of having experienced a delay, what was actually experienced were normal operating conditions.

When the taxi-out time is extended, the flight may arrive late at its destination. However, because published airline schedules do not include a specific taxi-out time component, a specific "tarmac delay" figure can not be calculated. 🌀

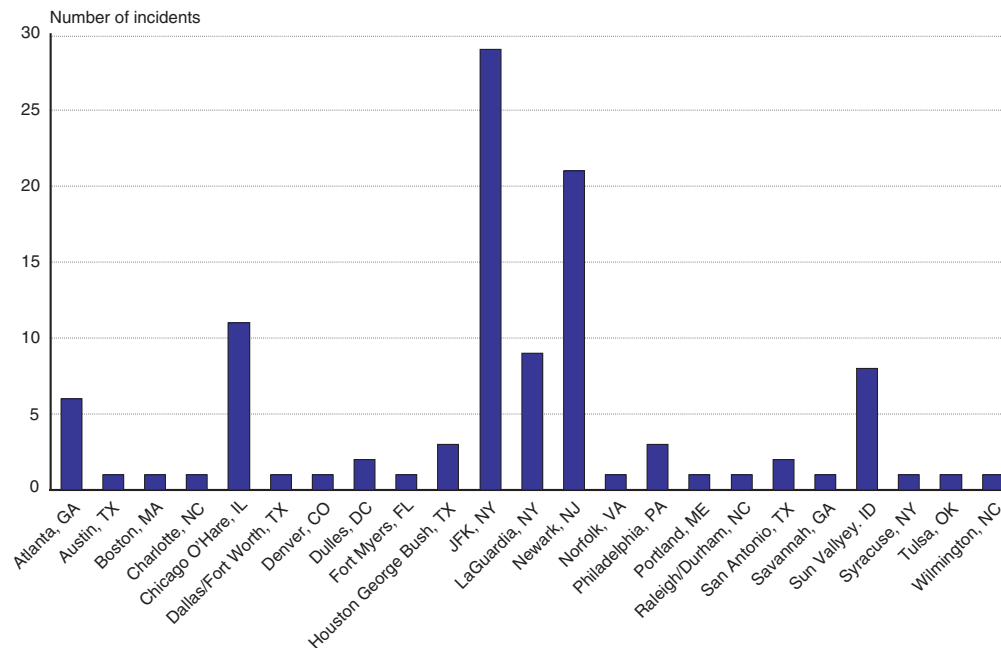
Table 6: Taxi-Out by Timeblock for Years 2006 and 2007

Taxi-out minutes	2006		2007	
	Flights with taxi out time data	Percent	Flights with taxi out time data	Percent
1-15	4,387,919	62.5	4,344,780	59.6
16-30	2,163,726	30.8	2,400,433	32.9
1-30	6,551,645	93.4	6,745,213	92.5
31-60	399,634	5.7	465,600	6.4
1-60	6,951,279	99.0	7,210,813	98.9
61-120	59,463	0.8	72,085	1.0
1-120	7,010,742	99.9	7,282,898	99.9
121-180	6,110	0.1	7,249	0.1
181-240	1,071	0.0	1,327	0.0
241-300	188	0.0	234	0.0
301+	36	0.0	44	0.0
121+	7,405	0.1	8,854	0.1
Total	7,018,147	100.0	7,291,752	100.0

NOTE: Percent subtotals may not add due to rounding. Does not include flights that returned to the gate and were then canceled.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Figure 9: Instances of Taxi-Out Times Greater Than 5 Hours Between Jan. 1, 2005–Dec. 31, 2007



NOTE: Does not include flights that returned to the gate and were then canceled.

SOURCE: U.S. Department of Transportation, Research and Innovative Technology Administration, Bureau of Transportation Statistics, Airline On-Time Performance Database.

Box B: About the Data

Detailed taxi-out data, including data by airport and by airline are available on the BTS website at http://www.bts.gov/programs/airline_information/taxi_out_times/. Note that on some website tables the data shown may differ slightly from the data presented here, as the following adjustments were made for the analyses in this report:

- Data for flights showing simultaneous gate departure and wheels-off (zero taxi-out time) were considered to be erroneous and were not included in calculations.
- Taxi-in times for some flights landing before midnight and arriving at the gate after midnight exceed 24 hours in the database due to data entry errors. Taxi-in times for these flights were adjusted before average taxi-in times were calculated.
- Taxi-out data for Comair in 2004 are not included in the calculation for table 5 due to data errors that could not be resolved and corrected.

About this Report

This article was prepared by Bruce Goldberg, Transportation Specialist at the Bureau of Transportation Statistics (BTS), and David Chesser, a Senior Economist contractor to BTS. BTS is a component of DOT's Research and Innovative Technology Administration.

This Special Report is based on data in the BTS Office of Airline Information On Time Performance Database, and the T-100 Database. Taxi-out and taxi-in time data is based on information reported monthly to BTS by the individual air carriers which includes, among other information, the time when flights leave the departure gate, leave the runway, touch down on the destination airport runway, and arrive at the gate after touching down. The total number of departures nationwide is taken from the T-100 database. Some adjustments have been made to the reported data, as outlined in the methodology box in this report.

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Data —

Airline Data and Statistics Program, BTS website

- Airline On-Time Performance—Taxi Out Times

Publications —

- *National Transportation Statistics*
- *Transportation Statistics Annual Report 2006*