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GAO

Report to Congressional Requesters

September 2011

AIRLINE PASSENGER PROTECTIONS

More Data and Analysis Needed to Understand Effects of Flight Delays

GAO-11-733

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GAO Accountability • Integrity • Reliability

Highlights

Highlights of GAO-11-733, a report to congressional requesters

Why GAO Did This Study

Flight delays and cancellations are disruptive and costly for passengers, airlines, and the economy. Long tarmac delays have created hardships for some passengers. To enhance passenger protections in the event of flight disruptions, the U.S. Department of Transportation (DOT) recently introduced passenger protection regulations, including a rule that took effect in April 2010 designed to prevent tarmac delays more than 3 hours (the tarmac delay rule), as well as other efforts to improve passenger welfare. As requested, this report addresses (1) whether flight delays and cancellations differ by community size; (2) how DOT's tarmac delay rule has affected passengers and airlines; and (3) how passenger protection requirements in the United States, Canada, and the European Union (EU) affect passengers and airlines. GAO analyzed DOT data, including through the use of regression models, as well as data from FlightStats, a private source of flight performance information. GAO also reviewed documents and interviewed government, airline, and consumer group officials in the United States, Canada, and the EU.

What GAO Recommends

GAO recommends that DOT collect and publicize more comprehensive data on airlines' on-time performance and assess the full range of the tarmac delay rule's costs and benefits and, if warranted, refine the rule's requirements and implementation. DOT did not comment directly on the recommendations, but indicated that it would soon begin a study of the effect of the tarmac delay rule.

View GAO-11-733 or key components.
For more information, contact Susan Fleming at (202) 512-2834 or flemings@gao.gov.

What GAO Found

Airports in rural communities have higher rates of delays and cancellations than airports in larger communities, but DOT data provide an incomplete picture of this difference. DOT's data include flights operated by the largest airlines, representing about 70 percent of all scheduled flights. GAO analysis of FlightStats data, representing about 98 percent of all scheduled flights, show more substantial differences in flight performance trends by community size than DOT data. DOT has historically not collected data from smaller airlines because of the burden it could impose on these airlines, but without this information, DOT cannot fully achieve the purpose of providing consumers with information on airlines' quality of service.

DOT's tarmac delay rule has nearly eliminated tarmac delays of more than 3 hours (180 minutes), declining from 693 to 20 incidents in the 12 months following the introduction of the rule in April 2010. While this has reduced the hardship of long on-board delays for some passengers, GAO analysis suggests the rule is also correlated with a greater likelihood of flight cancellations. Such cancellations can lead to long overall passenger travel times. Airlines and other aviation stakeholders maintain that the tarmac delay rule has changed airline decision-making in ways that could make cancellations more likely. To test this claim, GAO developed two regression models, which controlled for a variety of factors that can cause cancellations and measured whether the time period following the imposition of the tarmac delay rule is correlated with an increase in cancellations. The two models assessed flights canceled before and after leaving the gate, for the same 5 months (May through September) in 2009 and 2010. In both cases, GAO found that there was an increased likelihood of cancellation in 2010 compared to 2009 (see table).

Percent Difference in Likelihood of Flight Cancellation

Time on tarmac	Increased likelihood of cancellation in 2010 compared to 2009
Before taxi out (at gate)	24 percent more likely
1–60 minutes	31 percent more likely
61–120 minutes	More than twice as likely (214 percent)
121–180 minutes	More than 3 times as likely (359 percent)

Source: GAO analysis of DOT data.

EU requirements provide airline passengers with more extensive protections, such as care and compensation, for flight delays, cancellations, and denied boardings than do U.S. or Canadian requirements. But these protections may also increase costs for airlines and passengers. For example, some airline officials in the United States and the EU told GAO that increases in the amount of denied boarding compensation has increased their overall costs. Additionally, enhanced passenger protections, such as those in the EU, can create enforcement challenges if regulations are unclear or not universally enforced.

Contents

Tables

Figures

Abbreviations

ASQP	Airline Service Quality Performance
BTS	Bureau of Transportation Statistics
Commission	European Commission
CTA	Canadian Transportation Agency
DOT	U.S. Department of Transportation
ECJ	European Court of Justice
EU	European Union
FAA	Federal Aviation Administration
IG	Department of Transportation Office of Inspector General
UK	United Kingdom

GAO
Accountability * Integrity * Reliability

United States Government Accountability Office
Washington, DC 20548

September 7, 2011

The Honorable Nick J. Rahall, II
Ranking Member
Committee on Transportation and Infrastructure
House of Representatives

The Honorable Peter A. DeFazio
Ranking Member
Subcommittee on Highways and Transit
Committee on Transportation and Infrastructure
House of Representatives

Flight disruptions, including delays, cancellations, long tarmac delays, and denied boarding, are costly for passengers, airlines, and the economy. In recent years, roughly a quarter of all commercial flights have been delayed or canceled, resulting in tens of thousands of years in total delayed travel time and billions of dollars in out-of-pocket expenses and time lost for passengers each year.[1] With fewer empty seats than ever, opportunities for rebooking are often limited, exacerbating the disruptions and associated costs. Furthermore, these disruptions may be particularly challenging for smaller communities that have infrequent service. In a relatively few but widely publicized cases, long delays have occurred on the tarmac where passengers were held on planes for hours.[2] Passengers also can find themselves stranded or delayed when they are denied boarding because an airline has overbooked a flight.

[1]See Senate Joint Economic Committee, *Your Flight Has Been Delayed Again: Flight Delays Cost Passengers, Airline and the U.S. Economy Billions* (Washington, D.C.: May 2008), and M. Ball, C. Barnhart, M. Dresner, et al, *Total Delay Impact Study A Comprehensive Assessment of the Costs and Impacts of Flight Delay in the United States*, National Center of Excellence for Aviation Operations Research, Federal Aviation Administration (November 2010). This latter study estimated that the total cost of all U.S. air transportation delays in 2007 was $31.2 billion, with the $16.7 billion passenger component based on the passenger time lost due to schedule buffer, delayed flights, flight cancellations, and missed connections.

[2]According to the U.S. Department of Transportation, a "tarmac delay means the holding of an aircraft on the ground either before taking off or after landing with no opportunity for its passengers to deplane."

In the United States, airlines are generally not required to compensate passengers for their time or expenses when flights are delayed or canceled. In the European Union (EU), however, a regulation enacted[3] in 2004 guarantees care, such as lodging and meals, and financial compensation for passengers with disrupted travel plans.[4] Canada has promoted guidelines to encourage airlines to improve passenger protections, but has not otherwise required airlines to provide passenger care or compensation for flight disruptions. The U.S. Department of Transportation (DOT) has implemented some other passenger protections, including a recent regulation designed to mitigate hardships for airline passengers during long tarmac delays (the tarmac delay rule).[5]

You asked us to examine the extent of passenger protections in the United States, Canada, and the European Union (EU), as well as assess the trends in delays and cancellations in different-sized U.S. communities. We also assessed the effect of DOT's tarmac delay rule. Accordingly, this report addresses the following questions: (1) Do the trends in and reasons for flight delays and cancellations in the United States differ for smaller and larger communities? (2) How has DOT's tarmac delay rule affected passengers and airlines? (3) How have the requirements and practices for protecting passengers from flight delays, cancellations, and denied boardings in the United States, Canada, and the EU affected passengers and airlines?

To identify and compare the trends in and reasons for flight delays and cancellations in different-sized U.S. communities, we analyzed data from DOT and FlightStats, a private data source from Conducive Technology that records flight performance information. Specifically, we compared the

[3]In the EU, the European Commission, whose mission is to promote the general interest of the EU, initiates the legislative process by drafting specific pieces of legislation and proposing them to the Council of the European Union and European Parliament who together serve as the EU's legislative branch. Under the EU's co-decision procedure, both the Council of the EU and the European Parliament must approve legislation in order to enact a law. The European Union currently has 27 member states.

[4]Regulation (EC) 261/2004, art. 3, 2004 O.J. (L 46/1). The regulation was passed by the European Parliament and the Council of the European Union in 2004, but came into force in February, 2005.

[5]Throughout this report, we refer to the "tarmac delay rule," which is one component (contingency plans for lengthy tarmac delays) of the Enhancing Airline Passenger Protections Final Rule. 74 Fed. Reg. 68983 (Dec. 30, 2009). Unless otherwise stated, reference to the "tarmac delay rule" refers to this single component of the rule.

delay, cancellation, and diversion rates for all scheduled flights at different-sized airports and communities from 2005 to 2010. To better understand the reason for different trends, we reviewed a DOT Office of Inspector General report and interviewed aviation industry experts; representatives of industry associations and consumer groups; and representatives of the three biggest U.S. legacy airlines and three biggest low-cost airlines, based on passenger enplanements. To assess the extent to which the implementation of DOT's tarmac delay rule was associated with an increase in cancellations, we examined DOT data on tarmac delay trends and also constructed two multivariate logistic regression models. Incorporating data from DOT, the Federal Aviation Administration (FAA), and the National Oceanic and Atmospheric Administration, the regression models controlled for factors that can lead to flight cancellations, including weather, to assess how the rule's implementation affected the likelihood of flight cancellations. Two aviation industry experts assessed our models' structure and provided feedback that we incorporated into our approach as appropriate. We also spoke with representatives of U.S. airlines, industry associations, consumer groups, and DOT about the rule's impact on passengers and airlines. To assess the reliability of DOT and FlightStats data, we reviewed existing documentation related to the data sources and interviewed knowledgeable officials at DOT and FlightStats about the data. We determined that the data were sufficiently reliable for the purposes of this report. To determine how the requirements and practices for protecting passengers from flight delays, cancellations, and denied boardings in the United States, Canada, and the EU have affected passengers and airlines, we examined the laws, regulations, international agreements, and voluntary commitments governing passenger protections in the three regions. We also reviewed the contracts of carriage for selected airlines in the three regions and examined DOT data on denied boardings in the United States. Furthermore, we interviewed airline, industry association, consumer group, and government officials in all three regions.

We conducted this performance audit from August 2010 through September 2011 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. See appendix I for more information on our scope and methodology.

Background

The U.S. passenger airline industry is principally composed of legacy, regional, and low-cost airlines. Legacy (sometimes called network) airlines support large, complex hub-and-spoke operations with thousands of employees and hundreds of aircraft (of various types), with flights to domestic communities of all sizes as well as to international destinations.[6] Generally, regional airlines operate smaller aircraft than legacy airlines—turboprops or regional jets with up to 100 seats—and often operate flights marketed by a legacy airline.[7] Low-cost airlines generally entered the marketplace after the U.S. airline industry was deregulated in 1978 and typically have a less extensive network and lower operating costs.

Passengers access flights offered by these various airlines in the United States through hundreds of commercial-service airports.[8] Primary airports are classified on the basis of passenger traffic as large, medium, small, and nonhub.[9] Passenger traffic at these airports is highly concentrated: about 70 percent of passengers enplaned at the 29 largest airports and another 19 percent enplaned at the 36 next largest airports in 2009, the most recent year for which these data are available. Some of these largest airports also face significant congestion and delay issues. As we recently reported, seven large airports were the source of about 80

[6]The modifier "legacy" derives from the fact that these airlines were operating when the industry deregulated in 1978. Although the airline industry is now largely free of economic regulation, it remains regulated in other areas, most notably safety, security, and operating standards.

[7]Many regional airline flights are operated under a fee-for-service arrangement whereby the airline marketing the flight has decision-making control over most of the inventory of the airline operating the flight, including the decision to cancel flights.

[8]Commercial service airports are defined by 49 U.S.C. § 47102 as public airports that the Secretary of Transportation determines have 2,500 passenger boardings (enplanements) each year and receive scheduled passenger aircraft service.

[9]FAA divides commercial service airports into primary airports (enplaning more than 10,000 passengers annually) and other commercial service airports. Among primary airports, "nonhub" airports enplane fewer than 0.05 percent of systemwide passengers, "small" hub airports enplane at least 0.05 percent but fewer than 0.25 percent of systemwide passengers, "medium" hub airports enplane at least 0.25 percent but fewer than 1 percent of systemwide passengers, and "large" hub airports enplane at least 1 percent of systemwide passengers. 49 U.S.C. § 47102.

percent of departure delays captured in FAA's Operations Network in 2009.[10]

The national airspace system in which these airlines and airports operate is a complex, interconnected, and interdependent network of systems, procedures, facilities, aircraft, airports, and people that must work together to ensure safe and efficient operations. FAA, DOT, airlines, and airports all affect the efficiency of national airspace system operations. In particular, DOT and FAA set policy and operating standards for aircraft and airports.

As we previously reported, the capacity of the aviation system to meet the demand of aviation system users is both variable and subject to a number of interrelated factors.[11] The capacity of the aviation system is affected not only by airports' infrastructure, including runways and terminal gates, but also by weather conditions and air traffic control that can, at any given time, result in disruptions and variation in available airport and system capacity. For example, some airports have parallel runways that can be used simultaneously in good weather but are too close together for simultaneous operations in bad weather. In severe weather, airports can close, resulting in aircraft being grounded both at the closed airport and at other airports where aircraft cannot depart for the closed airport. The number of aircraft that can be safely accommodated in a given portion of airspace further affects capacity. If too many aircraft are trying to use the same airspace, some may be delayed on the ground or en route. For example, delays often occur in the New York City area because air traffic is so heavy, with three major airports located within 100 miles of each other. Airlines' scheduling and business practices can also exacerbate

[10]FAA's Operations Network provides information on which airports delays were attributed to—that is, which facility instituted a traffic management initiative that resulted in flights being delayed. In 2010, we reported that seven airports—Newark Liberty International, New York John F. Kennedy International, New York LaGuardia, Atlanta Hartsfield International, Philadelphia International, Chicago O'Hare International, and San Francisco International—were the main drivers of departure delay across the system and that these airports accounted for about 80 percent of departure delays at airports across the national airspace system. See GAO, *National Airspace System: Setting On-Time Performance Targets at Congested Airports Could Help Focus FAA's Actions*, GAO-10-542 (Washington, D.C.: May 26, 2010).

[11]GAO-10-542; *National Airspace System: Long-Term Capacity Planning Needed Despite Recent Reduction in Flight Delays*, GAO-02-185 (Washington, D.C.: Dec. 14, 2001); and GAO, *Air Traffic Control: Role of FAA's Modernization Program in Reducing Delays and Congestion*, GAO-01-725T (Washington, D.C.: May 10, 2001).

airport congestion and delays. For instance, some airline business models rely on tight turnaround times between flights, which can increase the likelihood of delays for flights scheduled later in the day. Additionally, airlines sometimes schedule flights during certain periods to accommodate passenger demand without considering an airport's available capacity.

When flights are disrupted—whether caused by reductions in system capacity (such as during bad weather) or by internal factors (such as aircraft mechanical problems or crew shortages)—airlines make trade-offs between long delays and cancellations, though they generally try to avoid canceling flights.[12] In doing so, they attempt to minimize disruptions to their network and passengers. For example, when bad weather reduces airport capacity and fewer flights can take off or land, airlines must decide how to ration their traffic. They can hold to their schedule, recognizing that some flights may experience long delays, or they can cancel some flights to avoid long delays for the remaining flights. How airlines manage such trade-offs depends on their business models and the circumstances of each situation.

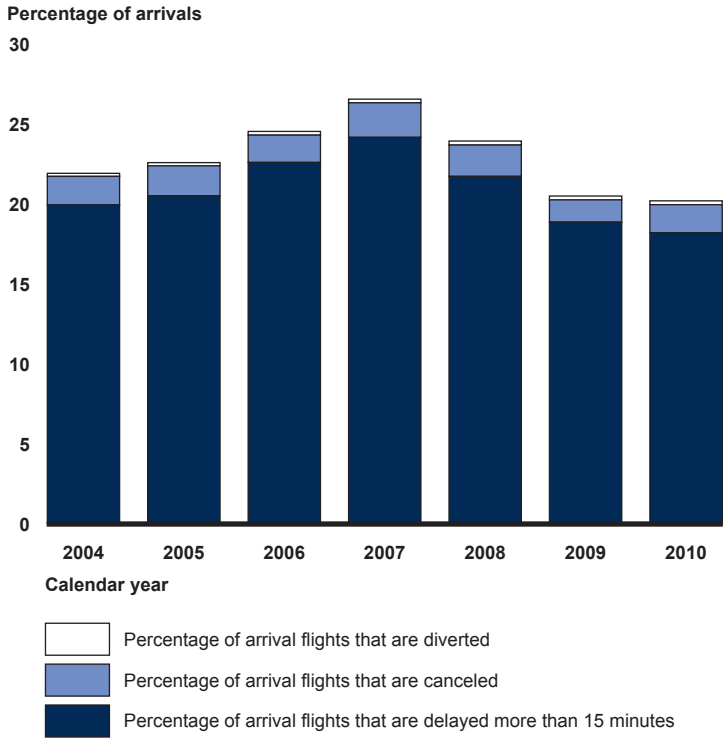
As we recently reported, flight delays and cancellations have declined since 2007, largely because airlines have scheduled fewer flights during the economic downturn.[13] From 2007 through 2010, the portion of flights that were delayed—that is, arrived at least 15 minutes later than scheduled—or were canceled or diverted decreased by 6 percentage points, according to DOT data (see fig. 1). Indeed, cancellations rates also peaked in 2007 at 2.16 percent of all flights, before declining to 1.39 percent in 2009 and 1.76 percent in 2010. Nevertheless, as we previously reported, airports still experience and contribute substantial delays to the system.[14]

[12]See Bengi Manley and Lance Sherry, *The Impact of Ground Delay Program (GDP) Rationing Rules on Passenger and Airline Equity*, Center for Air Transportation Systems Research, George Mason University (2008); Nicholas G. Rupp, *An Investigation Into the Determinants of Flight Cancellations,* East Carolina University (2005); and Zalman Shavell, *The Effects of Schedule Disruptions on the Economics of Airline Operations*, Mitre Corporation (2000).

[13]GAO-10-542.

[14]GAO-10-542.

Figure 1: Percentages of Delayed, Canceled, and Diverted Arrival Flights Systemwide, Calendar Years 2004–2010



Source: GAO analysis of DOT data.

In recent decades the airline industry's earnings have been extremely volatile. Despite some periods of strong growth and increased earnings, airlines have at times suffered such substantial financial distress that some have filed for bankruptcy. According to a recent FAA-sponsored research study, U.S. passenger airlines lost more than $60 billion from 2000 through 2008 on revenues of just more than $1 trillion.[15] An inefficient air transportation system that contributes to flight delays and cancellations increases airline costs and reduces demand for air travel, compounding these financial challenges.

[15]M. Ball, C. Barnhart, M. Dresner, et al, *Total Delay Impact Study A Comprehensive Assessment of the Costs and Impacts of Flight Delay in the United States*, National Center of Excellence for Aviation Operations Research, FAA (November 2010).

Airline industry financial pressures have led airlines to change certain business practices in order to cut costs and enhance revenue. For example, airlines have adjusted their capacity to increase passenger load-factors (i.e., the proportion of available seats filled with passengers). As a result, a large number of cancellations by an airline cannot be absorbed easily into later flights and, increasingly, airlines will not rebook passengers on other airlines' flights because of the costs involved. Passengers on canceled flights can then face long overall trip delays. In addition, for decades airlines have sought to reduce the revenue losses associated with passengers who do not show up for flights by accepting reservations for more passengers than they have seats. Because the number of no-shows is not entirely predictable, there is an element of risk in overbooking flights. If too many reservations are accepted and more passengers show up at departure time than the aircraft can carry, the airline must deal with the costs and customer service issues that arise when some customers are denied boarding. On the other hand, if the airline does not accept enough reservations for the flight and the number of no-shows is greater than expected, the airline loses revenue from empty seats that could otherwise have been occupied and some passengers are denied the opportunity to book their first-choice flight even though that flight could have accommodated them. DOT has long required airlines to solicit and compensate volunteers on oversold flights before anyone is bumped involuntarily and has also mandated financial compensation for passengers who are involuntarily denied boarding because their flights were oversold.[16]

Passenger complaints about delays, cancellations, and denied boardings, including complaints about being held in an aircraft for many hours while awaiting takeoff, have led Congress to consider stronger passenger protections. For instance, after hundreds of passengers were stuck in planes on snowbound Detroit runways for more than 8 hours in January 1999, both the House of Representatives and Senate conducted hearings on airlines' treatment of air travelers and considered whether to enact a "passenger bill of rights." The Air Transport Association and its member airlines maintained that they should have an opportunity to improve their customer service without legislation and executed an Airline Customer Service Commitment on June 17, 1999, in which each of the member

[16]14 C.F.R. part 250.

airlines agreed to prepare a customer service plan.[17] In 2000, AIR-21 mandated a review by the DOT Office of Inspector General (IG) of the extent to which each airline met all provisions of its customer service plan.[18] In its 2001 report, the IG found that, overall, airlines were making progress toward meeting their plan provisions and that their efforts had been a plus for air travelers. However, the IG also reported "significant shortfalls in reliable and timely communication with passengers by the airlines about flight delays and cancellations." Furthermore, the IG found that the airlines had not directly addressed the root cause of customer dissatisfaction—flight delays and cancellations—and had not indicated how they planned to remedy these problems in areas under their control. Other passenger rights bills were introduced in Congress in 2001, 2007, 2009, and 2011.[19] These bills were also designed to establish and enhance airline passenger protections, and the 2007, 2009, and 2011 bills explicitly limited tarmac delays to 3 hours. However, the 2001, 2007, and 2009 bills were not enacted, and the 2011 bill has not yet been enacted during this Congress.

In recent years, DOT has adopted rules to enhance passenger protections. First, in 2008, it amended its overbooking rule to increase the required compensation for involuntarily denied boarding, among other things.[20] Second, in late 2009, after a lengthy rulemaking and a task force report on long tarmac delays, DOT issued its first "Enhancing Airline Passenger Protections" rule.[21] The final rule, in effect since April 29, 2010, requires certain U.S. airlines to develop and implement a contingency plan for lengthy tarmac delays, including an assurance that,

[17]Though an Airline Passenger Bill of Rights Act was introduced in 1999 to provide "enhanced protections for airline passengers," it did not come to a vote. Airline Passenger Bill of Rights Act of 1999, H.R. 700, 106th Cong. (1999).

[18]Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21), Pub. L. No. 106-181, § 224, 114 Stat. 61, 103 (2000).

[19]Airline Passenger Bill of Rights Act, H.R. 1734, 107th Cong. (2001); Airline Passenger Bill of Rights Act of 2007, S.678, 110th Cong. (2007); Airline Passenger Bill of Rights Act of 2009, S.213, 111th Cong. (2009); Airline Passenger Bill of Rights Act of 2011, H.R. 729, 112th Cong. (2011).

[20]73 Fed. Reg. 21026 (Apr. 18, 2008).

[21]74 Fed. Reg. 68983 (Dec. 30, 2009).

for domestic flights,[22] the airline will not allow a tarmac delay to exceed 3 hours unless the pilot-in-command determines that there is a safety-related or security-related impediment to deplaning passengers, or that air traffic control has advised the pilot-in-command that deplaning would significantly disrupt airport operations.[23] The airlines' contingency plans must also include an assurance that adequate food and potable water will be provided no later than 2 hours after the aircraft leaves the gate (or touches down, in the case of an arrival), unless the pilot-in-command determines that safety or security considerations preclude such service. Failure to comply with these rules could be considered an unfair or deceptive practice[24] and may subject the airline to enforcement action and a fine of up to $27,500 per violation.[25] Furthermore, under the rule, the holding out—advertising or operating—of any chronically delayed flight is considered an unfair and deceptive practice and an unfair method of competition. The rule also requires a variety of other actions on the part of airlines to protect and better inform passengers.

In April 2011, DOT issued its second "Enhancing Airline Passenger Protections" rule.[26] This rule—which partially went into effect in August 2011 and will be fully implemented in January 2012—requires airlines, among other things, to reimburse passengers for baggage fees if their bags are lost, provide consumers with greater compensation for

[22]For international flights that depart from or arrive at a U.S. airport, a contingency plan must provide that an airline will not permit an aircraft to remain on the tarmac for more than a set number of hours, as determined by the airline, before allowing passengers to deplane. The exceptions for domestic flights apply to international flights, as well.

[23]74 Fed. Reg. 68983 (Dec. 30, 2009), codified at 14 C.F.R. § 259.4. This rule applies to all certificated and commuter air carriers (i.e., U.S. airlines) that operate scheduled passenger service or public charter service using any aircraft originally designed to have a passenger capacity of 30 or more seats. These requirements also only apply to flights at large- and medium-hub airports.

[24]49 U.S.C. § 41712.

[25]14 C.F.R. § 383.2(a) prescribes penalties for civil violations, including those under 49 U.S.C. § 41712.

[26]79 Fed. Reg. 23110 (Apr. 25, 2011).

involuntarily denied boarding, and disclose all fees for optional services.[27] The new rule also expands the existing tarmac delay rule to cover all U.S. large-, medium-, small-, and nonhub airports as well as foreign airlines' operations at those U.S. airports, and establishes a 4-hour time limit on tarmac delays for international flights of U.S. and foreign airlines, subject to safety, security, and air traffic control exceptions.

Like the United States, Canada, and EU also have laws, regulations, and guidance governing consumer protection for air travelers, including airline responsibilities to passengers when flight plans are disrupted. U.S., Canadian, and EU airlines generally must adhere to the passenger protection requirements of the region from which they are departing.[28] Airlines in all three regions also have contracts of carriage in which they may provide for passenger care, compensation, or both in the event of a flight disruption.[29] Thus, when provided for in law or in a contract of carriage,[30] passengers may be entitled to assistance, compensation, or both from their airline when a flight delay, cancellation, or denied boarding

[27]On July 20, 2011, DOT extended the effective date of certain provisions of the rule from August 23, 2011 to January 24, 2012. Specifically, DOT extended the effective date of requirements pertaining to full fare advertising, specific baggage fee disclosures, post-purchase price increases, flight status notifications (e.g., notifications to passengers in the event of delays, cancellations, or diversions), and holding a reservation without payment. DOT did not extend the effective date for the tarmac delay provisions. 76 Fed. Reg. 45181 (July 28, 2011). GAO, *Commercial Aviation: Consumers Could Benefit from Better Information about Airline-Imposed Fees and Refundability of Government-Imposed Taxes and Fees*, GAO-10-785 (Washington, D.C.: July 14, 2010).

[28]EU airlines departing outside of the EU but bound for an EU airport are required to adhere to EU regulations, except where the country of departure has provided benefits or compensation or assistance. Regulation (EC) 261/2004, art. 3, 2004 O.J. (L 46/1).

[29]Additionally, these three regions also prescribe requirements for what must addressed in an airline contract of carriage. For example, Canada's Air Transportation Regulations require airlines to clearly state in their contracts of carriage their policies related to the treatment of passengers, including their policies related to flight delays, cancellations, and denied boarding. Air Transportation Regulations SOR/88-58, Part V, Div. I, § 107(1)(n) (Can).

[30]According to DOT, many provisions of the contracts of carriage are also filed in the airlines' tariffs with DOT and with their governments.

occurs.[31] For example, under certain circumstances, some airlines offer food and beverage vouchers during flight disruptions. Finally, international standards and agreements also govern the rights of airline passengers, but only on international flights. Notably, the Montreal Convention, adopted in 1999 and ratified by the United States in 2003, provides that passengers can bring legal action against an airline for damages associated with flight delays.[32]

Airports in Rural Communities Have Higher Rates of Delays, Cancellations, and Diversions than Larger Communities, but DOT Data Provide an Incomplete Picture of These Trends

[31]In addition, in the United States, regulations require certain U.S. and foreign airlines to develop customer service plans to post on-time performance data for each flight on their Web sites. Airlines must state in these customer service plans certain commitments to passengers, such as the commitment to reimburse for any fee charged to transport a bag that is lost, notify customers of flight disruptions within 30 minutes of the airline's becoming aware of the disruption, and handle bumped passengers with fairness and consistency.

[32]Convention for the Unification of Certain Rules for International Carriage by Air (Montreal Convention), ch.3, art. 19, May 28, 1999 (entered into force on Nov. 4, 2003), *reprinted in* S. Treaty Doc. No.106–45. The Montreal Convention also limits airlines' liability for delays to 4150 Special Drawing Rights (or $6,658.87 as of July 22, 2011) per passenger. Montreal Convention, art. 22.

Airports in Rural Communities Have a Higher Rate of Delays, Cancellations, and Diversions than Larger Communities

The percentages of flights that are canceled or diverted have in recent years been higher to and from airports in rural communities than large metropolitan communities, according to FlightStats data.[33] We categorized airports based on the population size of their surrounding communities to assess the extent to which flight delays, cancellations, and diversions differ by community size.[34] Our analysis of departure cancellation and diversion trends, using FlightStats data for all reported flights, shows that, since 2005, flights from airports in rural communities (communities with less than 50,000 people) are on average about 3.5 times as likely to be canceled or diverted as flights from airports in large metropolitan communities.[35] For example, in 2010, cancellations and diversions accounted for roughly 2 percent of flights from large, midsized, and small metropolitan communities, compared with nearly 8 percent of flights from airports in rural communities (see fig. 2).[36] Greater cancellation rates for flights departing rural airports were matched by higher rates of cancellation for flights arriving at rural airports. (See app. II for more information). Such cancellations and diversions can lead to long overall delay times for passengers. According to one academic study, the

[33]FlightStats is an operating platform, owned and operated by Conducive Technology, which records flight performance information. This database includes more flight performance information than DOT's Airline Service Quality Performance System (ASQP) database. For example, the data we obtained included performance information for about 98 percent of U.S. scheduled passenger flights in 2010 from airports considered primary for fiscal year 2009, excluding airports in U.S. territories. ASQP data included about 77 percent of flights from those airports. In general, the ASQP data were more complete for airports in larger communities. For example, only about 45 percent of all flights from airports in rural communities were captured by ASQP.

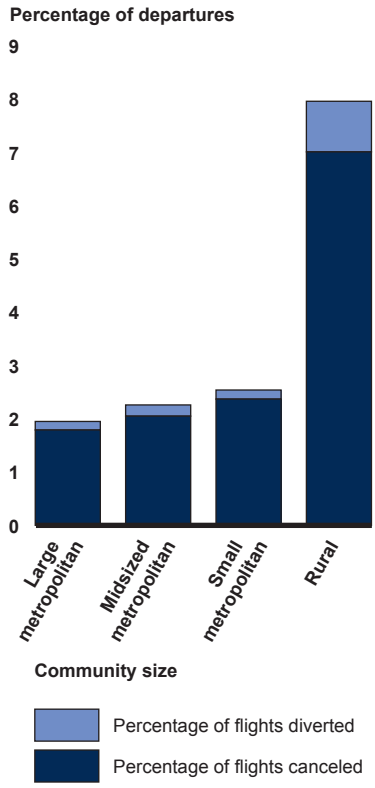
[34]Specifically, we grouped all airports considered primary for fiscal year 2009, excluding airports in U.S. territories, into four categories based on population: greater than or equal to 1 million (large metropolitan), 250,000 to 999,999 (midsized metropolitan), 50,000 to 249,999 (small metropolitan), and fewer than 50,000 (rural). This approach controls for the fact that some small or medium airports—generally secondary airports such as Hobby Airport in Houston—are actually in large metropolitan regions. Using these categories, in 2010, we examined data from 76 airports in large metropolitan communities, 99 in midsized metropolitan communities, 117 in small metropolitan communities, and 52 in rural communities. We excluded commercial service, nonprimary airports because they handle fewer than 10,000 enplanements annually and therefore are not considered airports that provide connectivity to the national airspace system.

[35]A flight is "diverted" if it lands at an airport other than its scheduled destination because of extreme weather or security concerns, for example.

[36]This 8 percent figure for 2010 represented 6,844 departure cancellations and 932 departure diversions from airports in rural communities.

overall average delay time for passengers on canceled flights is about 5 hours.[37]

Figure 2: Percentage of Canceled or Diverted Departures by Community Size in 2010



Source: GAO analysis of FlightStats data.

Note: Community sizes are as follows: large metropolitan (greater than or equal to 1 million), midsized metropolitan (250,000 to 999,999), small metropolitan (50,000 to 249,999), and rural (fewer than 50,000). These data reflect the vast majority of scheduled passenger flights. In 2010, for example, the data included performance information for about 98 percent of U.S. scheduled passenger flights from primary airports excluding airports in U.S. territories.

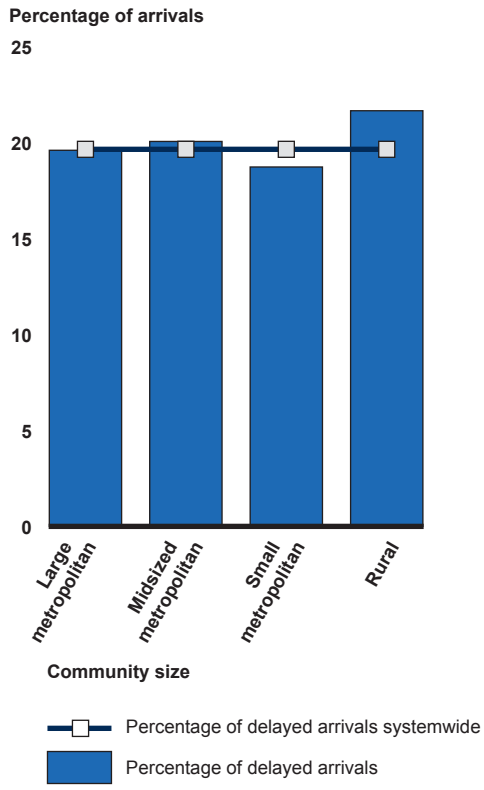
The percentage of delayed arrivals—that is, flights that arrived at least 15 minutes late to their destination—has in recent years been higher at

[37]Sherry, Lance, *Passenger Trip Delay Statistics for 2010*, Center for Air Transportation Systems Research at George Mason University. To be presented at the Transportation Research Board 91st Annual Meeting (January 2012).

airports in rural communities than airports in small, medium, and large metropolitan sized communities, according to FlightStats data, though the difference is not as substantial for delays as it is with canceled or diverted flights. As shown in figure 3, while delays occurred in 19.6 percent of all reported flights systemwide in 2010, delays occurred in 21.7 percent of flights to airports in rural communities, a 2.1 percentage points or about 11 percent difference in the occurrence of delay. See appendix II for arrival and departure delay trends since 2005. Such delays can lead to longer overall trip times for passengers. According to academic research, the overall average delay time for passengers on a delayed flight is 37 minutes.[38]

[38]Lance Sherry, *Passenger Trip Delay Statistics for 2010*. DOT also reports average delay times for aircraft. Since 2005, the average delay per delayed aircraft arrival is about 55 minutes.

Figure 3: Percentage of Delayed Arrivals by Community Size and Systemwide in 2010



Source: GAO analysis of FlightStats data.

Note: Community sizes are as follows: large metropolitan (greater than or equal to 1 million), midsized metropolitan (250,000 to 999,999), small metropolitan (50,000 to 249,999), and rural (fewer than 50,000). These data reflect the vast majority of scheduled passenger flights. In 2010, for example, the data included performance information for about 98 percent of U.S. scheduled passenger flights from primary airports, excluding airports in U.S. territories.

DOT's Data Provide an Incomplete Picture of Flight Delay, Cancellation, and Diversion Trends

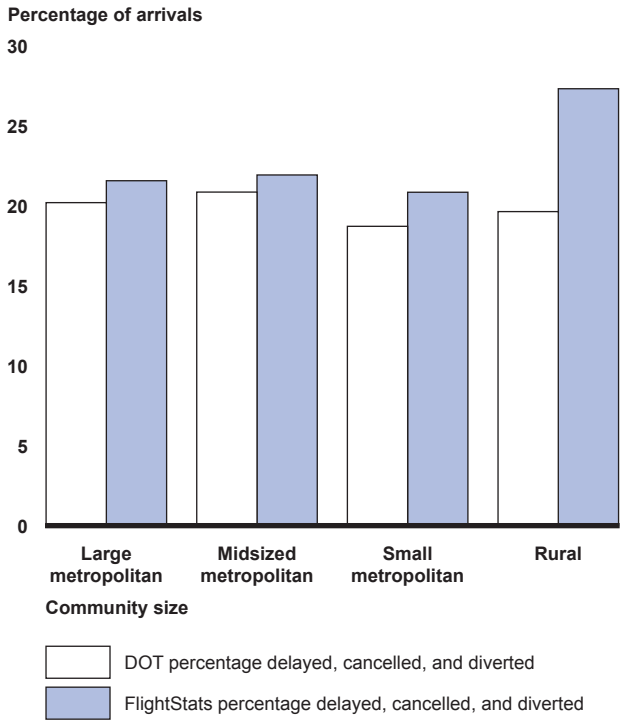
DOT's data on flight performance do not show similar disparities between rural and other airports as do the FlightStats data because many flights captured by FlightStats are not required to be reported to DOT. As a result, DOT data provides an incomplete picture of delay, cancellation, and diversion trends. DOT requires airlines with at least 1 percent of total domestic scheduled passenger service revenue to report flight performance data for flights they operate to and from reportable

airports.[39] In 2010, 18 airlines reported data, which accounted for 22 percent of all commercial airlines, 69 percent of all scheduled flights, and 85 percent of all passengers. The approximately 31 percent of flights not in DOT's data are scheduled flights operated by airlines that are not required to report. Some of these flights are those operated by regional airlines for legacy airlines, and in general the airlines not required to report to DOT are small and tend to provide much of the service to airports in small metropolitan and rural communities. Therefore, DOT's data do not provide a complete picture of flight performance, especially at airports in smaller communities. For example, according to DOT's data for 2010, delays, cancellations, and diversions occurred in 19.6 percent of flights to airports in rural communities and 20.2 percent of flights to airports in large metropolitan communities. However, FlightStats' more extensive data show a bigger difference by community size, with 27.3 percent of flights to airports in rural communities delayed, canceled, or diverted, compared with 21.6 percent of flights to airports in large metropolitan communities in 2010 (see fig. 4).[40]

[39]14 C.F.R. part 234.

[40]Departure data also showed differences between FlightStats and DOT data, with FlightStats showing a slightly higher percentage of flights from airports in rural communities delayed, canceled, or diverted. However, FlightStats showed lower percentages of flights from airports in large, midsized, and small communities delayed, canceled, or diverted than did DOT data.

Figure 4: Percentage of Delayed, Canceled, and Diverted Arrivals by Community Size in 2010 for DOT and FlightStats Data



Sources: GAO analysis of DOT and FlightStats data.

Note: Community sizes are as follows: large metropolitan (greater than or equal to 1 million), midsized metropolitan (250,000 to 999,999), small metropolitan (50,000 to 249,999), and rural (fewer than 50,000). These data reflect the vast majority of scheduled passenger flights. In 2010, for example, the data included performance information for about 98 percent of U.S. scheduled passenger flights from primary airports, excluding airports in U.S. territories.

Our analysis of FlightStats' and DOT's delay and cancellation data suggests that airlines not required to report flight performance information to DOT have higher delay, cancellation, and diversion rates than airlines that are required to report. As figure 4 shows, delay, cancellation, and diversion rates are higher, regardless of community size, when using FlightStats data, as opposed to DOT data. FlightStats data includes a greater percentage of all flights than DOT's data, 98 versus 77 percent, and data trends are similar for similar flights within each data set. Therefore, airlines not required to report to DOT likely account for greater rates of delays, cancellations, and diversions. According to FlightStats data, in 2010, airlines that were required to report to DOT had lower

delay, cancellation, and diversion rates on average than the 20 largest airlines not required to report to DOT.[41]

This information corroborates what we were told by various stakeholders, including airline officials and aviation researchers. According to stakeholders that we spoke with, these differences may exist for multiple reasons (see fig. 5). For example, airlines operating from smaller airports may have limitations that affect their on-time performance, such as their use of smaller aircraft, which can face greater restrictions during certain weather events. As the DOT Office of Inspector General has reported, airports in rural communities may have higher delay and cancellation rates because the airlines serving them may have more limited resources, such as spare aircraft and crew, at those airports than at metropolitan airports.[42] Furthermore, when FAA institutes traffic management initiatives to meter air traffic to and from airports, airlines must choose which of their flights to delay or cancel. According to previous academic research and aviation stakeholders that we spoke with, airlines usually prioritize flights by revenue, number of passengers, aircraft size, route distance, and competition, or flight frequency.[43] In cases where marketing airlines control operational decisions for their regional partners, the marketing airlines may disproportionately delay or cancel flights operated by their smaller, regional partners because those flights tend to be operated with smaller aircraft with fewer passengers and shorter routes with less competition from other airlines. Our analysis of two legacy airlines shows that their regional partners generally have worse on-time performance. According to FlightStats data, in 2010, two large legacy airlines canceled 1.96 percent and 1.51 percent of their own flights, compared with 2.46 percent and 2.43 percent of the flights regional airlines operated for them. While cancellations to smaller communities may inconvenience a relatively small number of passengers, they may result in long trip delays if those smaller communities have infrequent

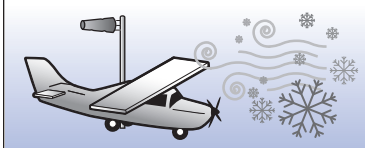
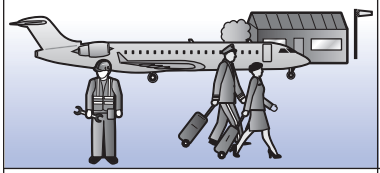
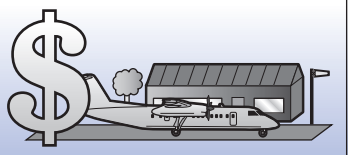
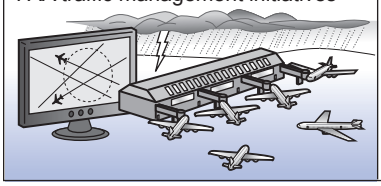
[41]Based on data for all reported flights, DOT reporting airlines' flights were delayed 19.54 percent, canceled 1.59 percent, and diverted 0.16 percent of the time. Nonreporting airlines were delayed 20.27 percent, canceled 2.48 percent, and diverted 0.25 percent of the time.

[42]Zinser, Todd, *Report on the Audit of Small Community Aviation Delays and Cancellations*, Report No. CR-2006-049 (May 19, 2006).

[43]N. Rupp and G. Holmes, *An Investigation into the Determinants of Flight Cancellations*. Also see, Jing Xiong, *Revealed Preference of Airlines' Behavior under Air Traffic Management Initiatives*, dissertation (2010).

service. See appendix II for more information on sources of delay and cancellations.

Figure 5: Examples of Sources of Delay by Community Size

Factors that may affect delay	Details
Aircraft type 	Smaller airplanes (which generally service small airports in rural communities) are more likely to be restricted during certain weather events. For example, according to the DOT Office of the Inspector General, these planes are not allowed to fly over some weather patterns or land in some wind conditions, which may delay these planes or force them to cancel at some airports and not others.
Airport size 	Airports in rural communities are generally smaller and therefore may have more air carrier delays because airlines have fewer resources available to respond to mechanical and staff issues.
Airline economic resources 	Airline economic decisions may also affect cancellation and delay trends. When extenuating circumstances, such as weather or congestion, force airlines to reduce the number of flights they can operate, airlines must choose which flights to delay or cancel. Airline decisions that take into consideration the number of passengers affected, access to alternative routings, or other factors may affect smaller communities either positively or negatively, according to the DOT Office of the Inspector General.
FAA traffic management initiatives 	FAA traffic management initiatives that restrict traffic to certain airports or geographic areas at certain times in response to events such as weather or congestion are more prevalent at larger airports.

Sources: GAO analysis of aviation research and interviews with airline officials.

DOT has historically not collected flight performance information from smaller airlines because of the burden it has perceived would be placed

on these airlines.[44] Without this information, though, DOT cannot provide consumers with a complete picture of flight performance, particularly at airports in smaller communities or for smaller airlines.[45] More comprehensive data would provide consumers with better information on airlines' performance. Requiring airlines with a smaller percentage of the total domestic scheduled passenger service revenue, or airlines that operate flights for other airlines, to report flight performance information are two ways that would enhance DOT's data. According to DOT officials, they have considered reducing the reporting threshold from 1 percent of domestic scheduled revenue to 0.5 percent to increase the percentage of flights captured. This change, they estimate, would require an additional 12 airlines to report to DOT and increase coverage from about 85 percent to more than 96 percent of all passengers. In its December 2009 passenger protections rule, DOT required airlines that are required to report on-time performance data to DOT to include on-time performance information on their Web sites for all flights for which their sites have schedule information. In doing so, it rejected the concern that airline publication of data from smaller code-sharing airlines on their Web sites would be overly burdensome, and also noted that flight performance information was necessary for consumers to make informed decisions when selecting flights.

[44]FlightStats uses flight schedules to track the actual performance of flights based on data from various airport and on-line sources. This generates extensive, real-time data on flights, which is then archived in its database. After reviewing the data and supporting documentation, as well as discussions with relevant officials, we determined that FlightStats data were sufficiently reliable for the purposes of this report.

[45]The purpose of this information is to provide consumers with information on airlines' quality of service. *See* 14 C.F.R. § 234.1.

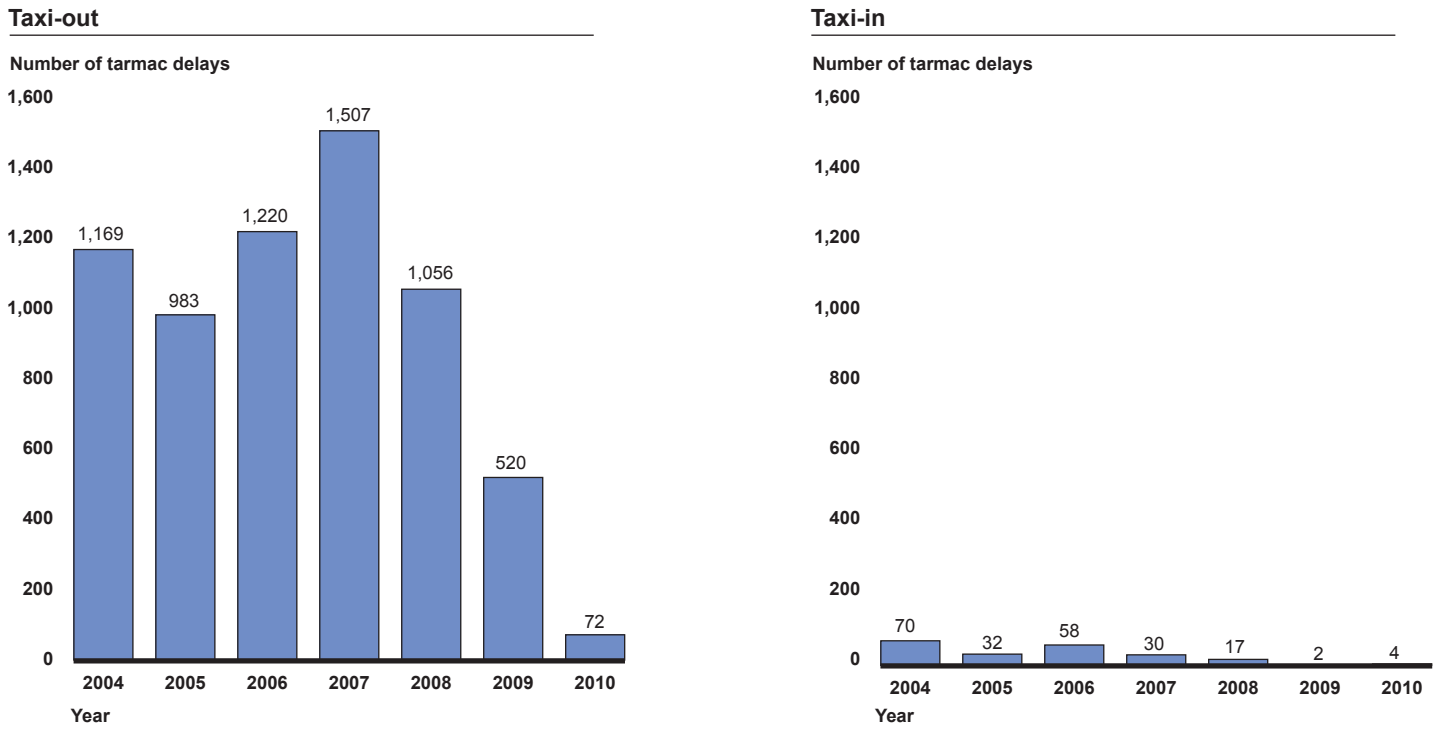
New Rule Has Nearly Eliminated Long Tarmac Delays but is Correlated with an Increase in the Likelihood of Flight Cancellations

The Number of Long Tarmac Delays Has Declined in Recent Years

Since 2004, tarmac delays of more than 3 hours peaked in 2007, three years before the tarmac delay rule was implemented. The decline prior to the imposition of the rule is likely the result of a combination of factors, including fewer flights since 2007, runway and other improvements at some airports, as well as voluntary limits adopted by some airlines on how long their flights can wait on the tarmac. Tarmac delays of more than 3 hours, which occur as a plane is taxiing out of or in to an airport gate ("taxi-out" or "taxi-in"), have historically been relatively uncommon, accounting for less than 0.1 percent of all reported flights, according to our analysis of DOT data (see fig. 6).[46] The vast majority, about 97 percent, of tarmac delays of more than 3 hours occur during taxi-out (departure), rather than during taxi-in (arrival).

[46]DOT data include information on tarmac delays of more than 3 hours for all domestic airlines that handle at least 1 percent of all domestic scheduled passenger service revenue. Since DOT determines annually which airlines meet the threshold and therefore must report flight performance data, the number of airlines required to report varies. In 2010, 16 airlines were required to report and 2 reported voluntarily. Since October 2008, DOT has required airlines to submit additional tarmac delay statistics. As of August 23, 2011, covered airlines, both United States and foreign, are required under 14 C.F.R. § 244.2 to report all passenger operations that experience a tarmac time of more than 3 hours at a U.S. airport, in a form as set forth in regulation. A covered airline includes all U.S. certificated air carriers, U.S. commuter airlines, and foreign airlines that operate passenger service to or from a U.S. airport with at least one aircraft that has an original manufacturer's design capacity of 30 or more seats. *See* 76 Fed. Reg. 23110, 23161 (Apr. 25, 2011).

Figure 6: Tarmac Delays of More than 3 Hours during Taxi-Out and Taxi-In by Year, January 2004–September 2010



Source: GAO analysis of DOT data.

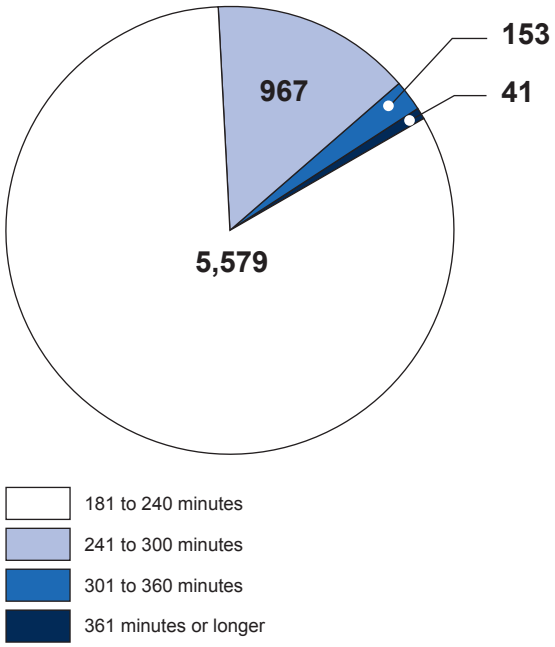
Notes: Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns prior to October 2008. Specifically, some airlines misreported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

The majority of all tarmac delays of more than 3 hours (180 minutes) since 2004 are 4 hours (240 minutes) or less (see fig. 7). Specifically, of the 6,740 tarmac delays of more than 3 hours reported from January 2004 through September 2010, almost 83 percent (or 5,579) were for 4 hours or less. However, given the length of some of these delays and the inconvenience or even hardship they sometimes create for passengers, tarmac delays have received widespread media attention (see app. IV for

examples of tarmac delays of more than 3 hours since October 2008, when DOT began collecting more data on such delays).[47]

[47]Starting in 2008, DOT began monitoring tarmac delays more closely, requiring reporting airlines to submit data on all tarmac delays. Prior to October 2008, airlines reported data on tarmac delays that occurred during taxi-out or taxi-in. Since October 2008, airlines have been required to submit long tarmac delay statistics for three additional categories: flights that are canceled after the tarmac delay, flights that return to the gate after the tarmac delay before taking off, and flights that experience extended tarmac delays during taxi-in at a diversion airport. In 2009, of the 868 long tarmac delays, one-third (283 flights) were captured in these new categories.

Figure 7: Total Tarmac Delays of More than 3 Hours (180 minutes) by Minutes of Delay, January 2004–September 2010



Source: GAO analysis of DOT data.

Notes: Tarmac delay trends, by delay time, are proportionally similar across years. As a result, we have combined the data for years 2004 through September 2010. In addition, the average length of taxi-out and taxi-in tarmac delays is similar, as is the proportion of those delays that extend beyond 3 hours. Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns prior to October 2008. Specifically, some airlines misreported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Tarmac delays of more than 3 hours are generally clustered around certain weather events, during specific times of the year or day, and at specific airports. For example, tarmac delays of more than 3 hours most often occur during summer thunderstorms or winter storms, when airport

departures are halted.[48] According to our analysis of DOT data from January 2004 through September 2010, almost two-thirds of all tarmac delays of more than 3 hours occurred from May through September. Also, these tarmac delays tend to be clustered on a select number of days. According to our analysis of DOT data, almost 74 percent of tarmac delays of more than 3 hours, from January 2004 through September 2010, occurred on about 7 percent of the days during this time period. For example, on July 23, 2008, 113 flights were delayed more than 3 hours on the tarmac across the national airspace system during taxi-out.[49] Tarmac delays also tend to occur in the late afternoon, when summer thunderstorms are most likely, and after delays from the morning and early afternoon are compounded. For example, since 2004, about half of all tarmac delays of more than 3 hours occurred between 3:00 p.m. and 6:00 p.m. local time. Tarmac delays are also most prevalent at airports that have high rates of delays. For example, about 55 percent of tarmac

[48]For the purposes of this report we consider the summer season to run from May through September.

[49]Since 2003, airlines have reported the cause of delay to DOT in one of five broad categories: late-arriving aircraft, airline, national airspace system, extreme weather, and security. Tarmac delays of more than 3 hours during both taxi-out and taxi-in are usually officially attributed by airlines to issues with the national airspace system. For example, since 2004, 86 percent of such taxi-out delays were attributed to the national airspace system, according to DOT data. The extent to which delays attributed to the national airspace system are related to weather events is unknown, since this reporting category includes delays caused by air traffic control issues, weather that slows down operations at an airport, or other ground congestion. Delays during taxi-in may also occur at diversion airports when Transportation Security Administration or Customs and Border Protection officials are not available at airports where passengers are arriving, according to one airline association. For example, a regional airline flight from Houston to Minneapolis that was diverted to Rochester, Minnesota, in the summer of 2009, sat on the tarmac in Rochester for more than 5 hours because there was severe weather and confusion over the Transportation Security Administration's after hours operating procedures. DOT fined Continental Airlines, which had contracted the ExpressJet flight, and ExpressJet each $50,000 for this incident. In addition, DOT assessed a civil penalty of $75,000 against Mesaba Airlines, which provided voluntary ground handling to ExpressJet, for providing inaccurate information to ExpressJet about deplaning passengers, which was found to be an unfair and deceptive practice in violation of 49 U.S.C. § 41712. DOT Order 2009-11-16 (Nov. 24, 2009).

delays of more than 3 hours since 2004 occurred at just seven particularly congested airports.[50] See appendix III for more details on these trends.

Tarmac Delays More than 3 Hours Have Been Nearly Eliminated Since DOT Implemented Rule

DOT instituted new rules in 2010 in response to instances of passengers subject to lengthy tarmac delays, among other consumer-related problems.[51] Since these rules took effect in April 2010, tarmac delays greater than 4 hours have been eliminated, and tarmac delays of more than 3 hours nearly eliminated, reducing the hardship of long on-board delays for some passengers. As mentioned earlier, these new rules require, among other things, that covered airlines' contingency plans provide for adequate food and water on all flights once a flight has been on the tarmac for 2 hours, except when safety or security preclude such services. Additionally, for domestic flights, the rule requires that covered airlines should not remain on the tarmac for more than 3 hours, with exceptions for safety, security, and disruption of airport operations.[52] Violation of these rules can result in a $27,500 per-violation fine.[53] Since the rule went into effect in late April 2010, tarmac delays of more than 3 hours (180 minutes) have been nearly eliminated (see fig. 8). In the first 12 months since the rule went into effect, airlines reported tarmac delays of more than 3 hours for 20 flights, compared with 693 over the same period prior to the rule.[54] Airline consumer groups we spoke with strongly support the tarmac delay rule instituted by DOT.

[50]In 2010 we reported that, according to FAA's Operations Network data, these seven airports—Newark Liberty International, New York John F. Kennedy International, New York LaGuardia, Atlanta Hartsfield International, Philadelphia International, Chicago O'Hare International, and San Francisco International—were the main drivers of departure delay across the system, and that these airports accounted for about 80 percent of departure delays at airports across the national airspace system. See GAO-10-542.

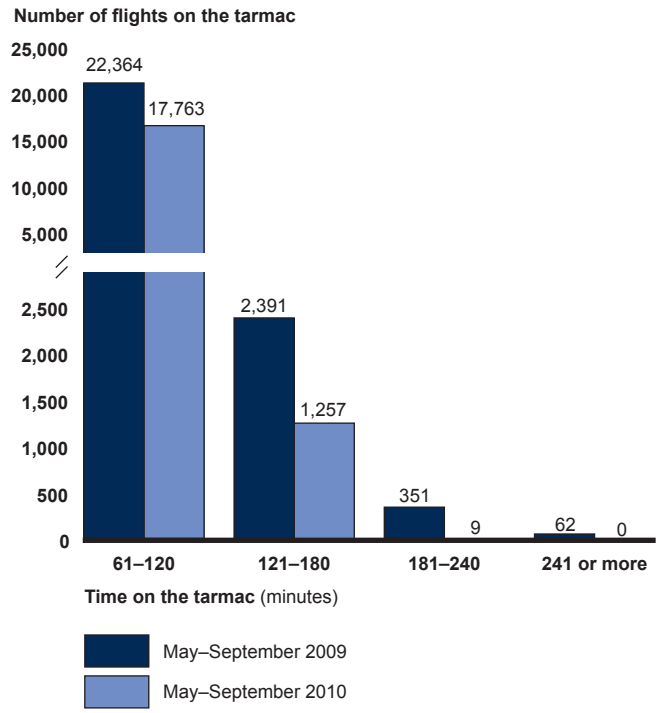
[51]Enhancing Airline Passenger Protections, 74 Fed. Reg. 68983 (Dec. 30, 2009).

[52]14 C.F.R. § 259.4(b). As noted previously, as of August 23, 2011, international flights of U.S. and foreign carriers are subject to a 4-hour time limit on tarmac delays, subject to exceptions for safety, security, and disruption of airport operations.

[53]14 C.F.R. § 383.2(a) prescribes penalties for civil violations, including those under 49 U.S.C. § 41712. The term "violation" is not defined in statute or regulation.

[54]Over these same time periods, tarmac delays of more than 4 hours went from 105 to 0.

Figure 8: Total Flights on the Tarmac of More than 1 Hour During Taxi-Out, May–September 2009 and 2010



Source: GAO analysis of DOT data.

Note: This information is based on DOT data for all reporting airlines systemwide.

A small number of flights have sat on the tarmac for more than 3 hours since the rule went into effect, including four that resulted in violations where airlines were warned. In the first 12 months after the implementation of the rule, DOT identified 20 incidents where flights were delayed on the tarmac more than 3 hours and determined that 11 of these did not violate the tarmac rule, 4 were violations which resulted in a warning to the airline, and 5 which are still under investigation (see app.

IV for a list of these flights).[55] Twelve of these 20 flights were canceled and none sat on the tarmac for more than 4 hours, according to DOT data.[56] DOT has not defined, in the regulation or elsewhere, what constitutes a violation of the rule that warrants a fine, though DOT enforcement officials told us that when determining whether to assess a fine, as well as how much to assess, they consider, among other things, the nature of the violation, the harm caused to passengers, whether the delay was preventable, and the size and financial condition of the airline. According to these officials, airlines are operating under the assumption that a fine could be assessed at $27,500 per passenger because DOT's current authority allows for penalties at up to $27,500 "per violation," a phrase which is not defined in statute or regulation.[57]

The Number of Flight Cancellations Have Increased Since DOT Implemented Rule

Overall, the number of flight cancellations have increased since the tarmac delay rule was implemented, according to DOT data, though these cancellations cannot be directly attributed to the rule.[58] Our analysis of cancellation trends examined flights during the last two summers, May through September, 2009 and 2010 because they represent equivalent periods of time before (2009) and after (2010) the implementation of the

[55]To date, two airlines have been fined in connection with the tarmac delay rule, but not for exceeding the 3-hour limit. United Airlines and Pinnacle Airlines were fined $12,000 and $10,000, respectively, in September 2010 for misreporting tarmac delays. Both airlines reported incurring delays of more than 3 hours to DOT on Bureau of Transportation Statistics Form 234 (On-Time Flight Performance Report). However, after an investigation was initiated by DOT, the department, or United Airlines in their respective situation, determined that they had made an erroneous report and the delay was under 3 hours. The airlines were fined for reporting inaccurate data. DOT Orders 2010-9-22, 2010-9-11. As of the spring 2011, DOT was also investigating potential violations of other aspects of the rule including the requirement to provide food and water service by 2 hours, cabin temperature, and the availability of lavatory services.

[56]Of the remaining flights, three were able to take off shortly after 3 hours, three returned to the gate prior to takeoff, and two were at a diverted airport and able to reach the gate.

[57]DOT officials told us that, although they are not required to, they could issue guidance on their penalty structure as it pertains to the tarmac delay rule, but have chosen not to in order to maintain flexibility under their current authority.

[58]We used DOT's ASQP flight performance data because FlightStats data are not sufficiently detailed for the analysis we present in this section. Further, though DOT data are more limited for smaller airlines and airports than FlightStats, the tarmac rule implemented on April 30, 2010, applied only to flights at large- and medium-hub airports. However, the April 2011 rule, effective August 23, 2011, expands the rule to small and nonhub airports.

rule. Furthermore, as noted previously, the summer historically accounts for the majority of tarmac delays. While the number of scheduled flights was similar in these time periods, total cancellations increased by 5,068 (see table 1).[59] Total cancellations as a percentage of all flights increased from 1 percent in 2009 to 1.2 percent in 2010, a 20 percent increase in the rate of cancellations. Cancellation rates also increased for the subset of flights that left the gate and then sat on the tarmac.[60] For example, the percentage of flights that were canceled after sitting on the tarmac for between 2 and 3 hours (121 to 180 minutes) increased from 6.19 percent in 2009 to 17.34 percent in 2010. As a result of challenges rebooking passengers, such cancellations can lead to long overall delay times.

Table 1: Cancellations by Stage of Flight, May–September 2009 and 2010

	2009			2010		
	Total cancellations		**Percent canceled of all flights**	**Total cancellations**		**Percent canceled of all flights**
Canceled before taxi-out	27,161		0.98%	31,985		1.16%
Time on tarmac (minutes)	**Total flights**	**Total cancellations**	**Percent canceled**	**Total flights**	**Total cancellations**	**Percent canceled**
1–60	2,711,384	824	0.03%	2,709,532	926	0.03%
61–120	22,364	259	1.16	17,763	396	2.23
121–180	2,391	148	6.19	1,257	218	17.34
181–240	351	57	16.24	9	7	77.78
241 or more	62	15	24.19	0	0	n/a
All flights	**2,763,713**	**28,464**	**1.0**	**2,760,546**	**33,532**	**1.2**

Source: GAO analysis of DOT data.

Note: This information is based on DOT data for all reporting airlines systemwide.

According to DOT, although cancellations have increased since the tarmac delay rule was implemented, few, if any, additional cancellations

[59]According to DOT data, scheduled flights only declined by 0.1 percent (or 3,167 flights) from 2009 to 2010.

[60]Overall, fewer flights were delayed on the tarmac for more than 1 hour in 2010 than were delayed in 2009, although the cancellation rate was higher for the 2010 flights. Specifically, from May through September 2010, 17,763 flights sat on the tarmac for more than 1 hour, compared with 22,364 during the same time period in 2009.

can be attributed to the introduction of the tarmac delay rule. DOT's analysis is limited, though, because it includes only a portion of all flights, considers the total number of cancellations instead of the rate of cancellation, and does not control for other factors that can affect cancellations. In a March 2011 analysis of flight cancellations from 2009 and 2010, DOT found that, for the period from May through October, the number of flights canceled after sitting on the tarmac for 2 hours or more increased by six flights from 2009 to 2010.[61] However, as indicated in table 1, the number of flights that remained on the tarmac for more than 2 hours (121 or more minutes) declined by more than half—2,804 to 1,266—from 2009 to 2010. As a result, the rate of cancellation increased from 2009 to 2010. DOT also did not control for the other factors, such as weather, that can affect an airline's decision to cancel a flight. When such factors are not controlled for, the observed changes in cancellations, and any associated costs, cannot be estimated. A complete consideration of the costs and benefits of the tarmac delay rule cannot be conducted without, at a minimum, controlling for these factors. Such a consideration is important because, according to the Office of Management and Budget, a fundamental indicator of a publicly acceptable rule is one in which public benefits exceed public costs.

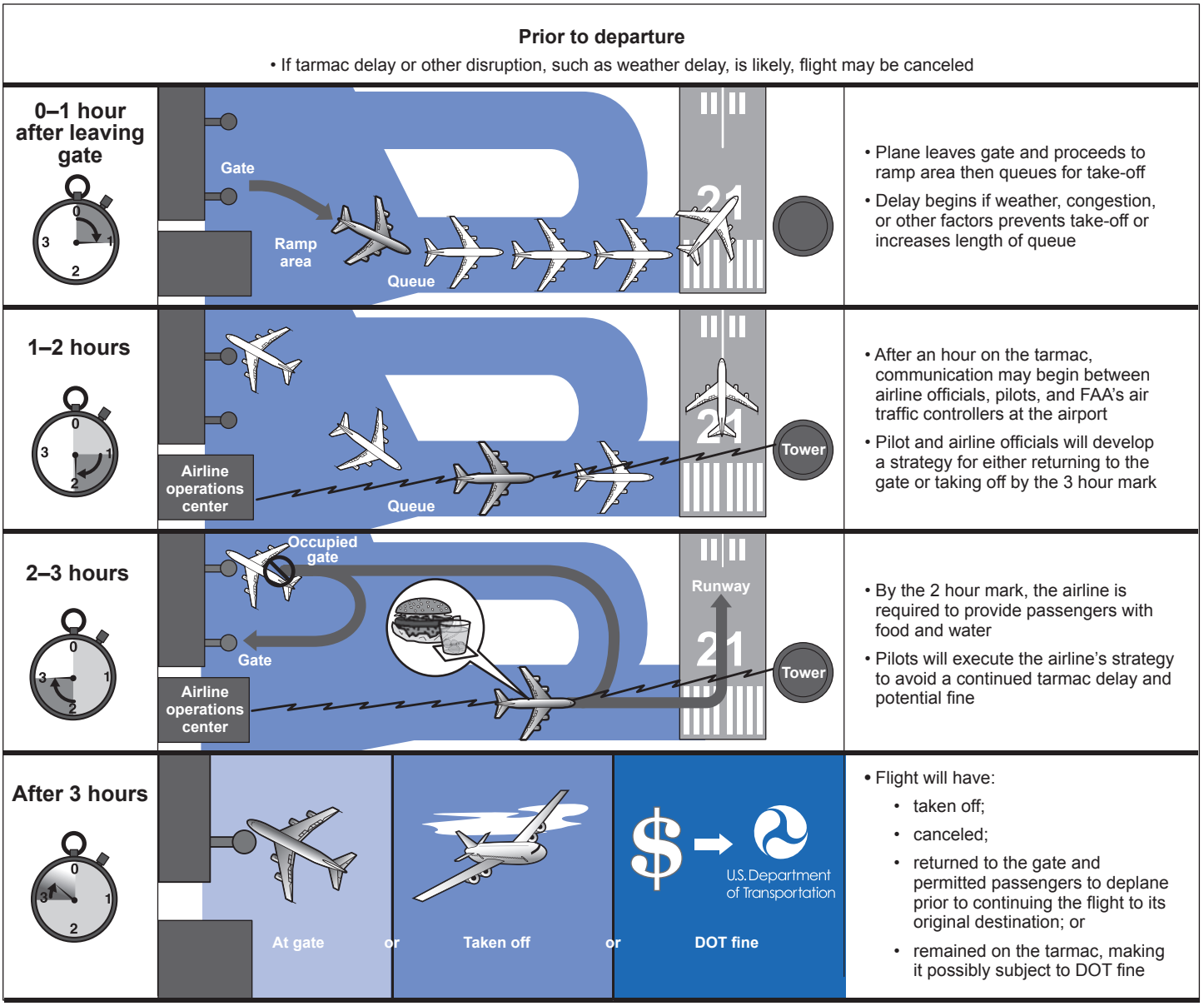
Airlines Maintain They Have Changed Decision Making in Response to Tarmac Delay Rule

Airline and other aviation industry stakeholders that we spoke with maintained that the tarmac delay rule has changed how airlines balance the trade-off between the extent to which flights are delayed and canceled, and that this change has made flight cancellations more likely. In particular, these officials told us airlines are more often taking actions to avoid potential DOT fines, including returning flights to the gate after taxi-out and, because of crew hour limits, limited gate availability, or the severity in the underlying cause of delay, some of these flights may then be canceled. Furthermore, when flights are delayed on the tarmac, airline officials told us they are now deciding sooner than they did in the past whether to taxi back in to the gate. A majority of the U.S. airline officials

[61]DOT limited its analysis to cancellations of flights that were delayed on the tarmac at least 2 hours because "they are virtually certain to be directly related to a lengthy tarmac delay." Using that criterion, in its December 2009 regulatory analysis of the final rule, DOT estimated that the rule would result in 41 additional canceled flights per year, affecting 3,176 passengers. According to DOT, the impact of additional cancellations on passengers varies. For passengers who boarded a flight before it is canceled, the majority will wait longer for another flight the same day, while others will return to the airport the following day.

we spoke with said that, once a flight is delayed on the tarmac, communications between airline officials and air traffic control officials on how to handle the delay, such as whether to wait or return to the gate now starts after about an hour (see fig. 9). According to airline officials we spoke with, uncertain taxi times for take off and the potential for million-dollar fines have made early decision making necessary because it may take a significant amount of time for a flight to return to the gate, if necessary. Additionally, within 2 hours, airlines must provide food and water. Airline officials also told us that when flights have been on the tarmac for 2 hours, the pilots begin executing a plan for either takeoff or a return to the gate within the hour. According to one airline official, this plan must then be carried out unless they are told by air traffic control that takeoff is imminent. Officials from one airline told us that their decision to return to the gate is sometimes put into action before the flight has been on the tarmac for 2 hours. As a result, airlines are returning more flights to the gate prior to takeoff. Our analysis of DOT data found that the number of flights returning to the gate after waiting on the tarmac for at least an hour has increased by almost 9 percent from May through September 2009 to May through September 2010, although it is not possible to definitively attribute these changes solely to the tarmac delay rule.

Figure 9: Domestic Airlines' Decision-Making Timeline for Flights Experiencing a Taxi-Out Delay on the Airport Tarmac



Sources: GAO analysis of tarmac delay rule and aviation stakeholder interviews.

Note: The decision-making timeline described in this figure is a general representation of airline decision-making processes based on academic studies and interviews with airline officials. The processes and decisions may vary between airlines based on their business practices and the specific circumstances.

In addition to stating that the tarmac delay rule is altering their decision making during a tarmac delay, airlines maintain that the rule has increased the likelihood that they will cancel a flight before it ever leaves the gate. For instance, airline officials told us that they are precanceling more flights prior to the scheduled departure time when long tarmac delays are possible, such as during severe weather, than they did in the past. According to an official from one airline, its precancellations have increased by 10 percent since late April 2010, when the rule went into effect. When canceling a flight before passengers have boarded the plane, airlines have more control over where they position crew and aircraft to resume normal operations the following day. According to one major airline, precanceling also benefits flight crews and airport employees because it gives airlines, airports, and passengers greater flexibility in rescheduling flights, work, and personal activities.[62]

Our Analysis Finds That the Tarmac Delay Rule is Correlated with an Increased Likelihood of Flight Cancellations

Since a variety of factors in addition to the tarmac delay rule may be correlated with airline cancellation decisions, we developed logistic regression models that control for several factors that are likely to be associated with these decisions in order to measure the likely effect of the tarmac delay rule.[63] We used two models to analyze cancellations. In the

[62]We also heard from some airlines that they have diverted more flights to avoid congested airports that may lead to long tarmac delays during taxi-in for those flights. According to officials we spoke with, this has included re-routing flights away from hub airports and "landing short" of their destination at an airport where they have resources to accommodate the diverted plane. Furthermore, to avoid challenges at the diversion airport, at least some airlines have altered where they divert to. Prior to the rule, airlines might have just landed at the closest airport. Now, however, they are being more proactive, choosing to land at airports where they have supplies (i.e., gate space, employees, and equipment) and are more equipped to handle the traffic. Since the implementation of the rule, arrival diversions have increased almost 5 percent from 7,272 to 7,617, according to DOT data for the summers of 2009 and 2010, when flight traffic levels were similar. However, this increase cannot necessarily be attributed to the implementation of the tarmac delay rule.

[63]A logistic regression (or logit method) provides an indication of which independent variables are correlated with the dependent variable—which in this case, is the incidence of a flight cancellation. Moreover, it provides this measure of correlation independent of the effects of the other independent variables included in the model. It is important to note, however, that this type of statistical method only suggests correlations between variables and not causation. That is, our findings do not provide an indication that any of the independent variables we included in the model actually caused (or did not cause) cancellations, but only how those variables are correlated with the incidence of cancellations.

first (the tarmac-cancellation model), we assessed the likelihood of cancellation for all flights that taxi-out from the gate. In the second (the gate-cancellation model), we assessed the likelihood of cancellation for flights before they leave the gate.[64] Our analysis examined flights during the last two summers (May through September 2009 and 2010) because DOT began collecting more extensive data on tarmac delays that is necessary for this analysis in October 2008 and, historically, the majority of tarmac delays occur in the summer.[65] Both models control for several factors that are likely to influence airlines' decisions about whether to cancel flights, including weather at the origin and destination airport, airline characteristics, and specific details of individual flights. Nevertheless, other factors related to cancellations may not have been fully controlled for. Additionally, since we used a variable indicating the year as a proxy for the implementation of the rule in late April 2010, other general changes in the environment across these two years which affect how airlines decide whether to cancel a flight may not be fully reflected in our model. See appendix V for a detailed discussion of the model structure, a full list of independent variables, and our full results.

Model Results

Results from the tarmac-cancellation model suggest that the implementation of the tarmac delay rule is associated with a greater likelihood of cancellation for flights that taxi-out onto the tarmac. Furthermore, our results suggest that the greater likelihood of cancellation increases with the time a plane stays on the tarmac. As shown in table 2, we grouped flights into hour-long intervals, and for each group the likelihood of cancellation has increased since the rule went into effect.

[64]Both models analyze flights between 70 airports in the United States and Puerto Rico. The FAA Aviation System Performance Metrics database includes performance data on operations at 77 airports. Our analysis included domestic flights operated by DOT reporting airlines to and from these airports, except for three in Alaska and Hawaii (Ted Stevens Anchorage International Airport, Honolulu International Airport, and Kahului Airport) which were not included and four (Gary Chicago International Airport, Greater Rockford Airport, Teterboro Airport, and Van Nuys Airport) that had no reported flights to or from the other 70 airports during the months of our analysis. The 70 airports used in our analysis mostly overlap with the large- and medium-hub airports at which flights were required to comply with the tarmac delay rule in 2010.

[65]Since our models used data only from 2009 and 2010, we did not need to exclude any particular flight records due to data reporting issues because, as noted earlier, DOT enhanced its tarmac delay data collection procedures in October 2008, improving its data reliability.

This correlation of the rule's implementation with increased cancellations appears consistent with what airlines have told us has happened.

Table 2: Percent Difference in Likelihood of Flight Cancellation after Implementation of Tarmac Delay Rule

Time on tarmac	Increased likelihood of cancellation in 2010 compared with 2009
Before taxi-out (at gate)	24 percent more likely
1–60 minutes	31 percent more likely
61–120 minutes	More than twice as likely (214 percent)
121–180 minutes	More than 3 times as likely (359 percent)

Source: GAO analysis of DOT data.

Notes:

1. These results are based on analysis of all flights, operated by DOT reporting airlines, to and from 70 of the FAA's Aviation System Performance Metrics 77 airports in the United States and Puerto Rico.

2. The percentage differences in the likelihood of cancellation presented here are based on odds ratios calculated from our models. In particular, the figure for cancellations before taxi-out is from our gate-cancellation model, which estimates the effect of different factors (including the implementation of the tarmac delay rule) on the odds of flights being canceled at the gate. The figures for cancellations after taxi-out are from our tarmac-cancellation model, which estimates the effect of different factors (including the implementation of the tarmac delay rule) on the odds of flights being canceled after taxi-out on to the tarmac. All figures reported in the table are statistically significant at the 1 percent level. Our tarmac-cancellation model also showed a large, statistically significant increase in the likelihood of cancellation in 2010 compared with 2009 for flights on the tarmac for more than 3 hours, but we excluded that information from this table because of the very small number of flights that experienced such long tarmac delays in 2010.

Results from the gate-cancellation model also indicate that the tarmac delay rule is associated with a higher rate of flight cancellation. In particular, when the model controlled for other factors that may be associated with an airline's decision to cancel a flight, the likelihood of a gate cancellation was 24 percent higher during May through September 2010 than it was for the same months in 2009 (see table 2). The gate-cancellation model also controlled for the same factors as the tarmac model except for minutes on the tarmac. For both models, the tarmac

delay rule as well as the other factors we included generally had the expected, and statistically significant, association with cancellations.[66]

EU Requirements Provide More Comprehensive Passenger Protections, but May Also Increase Costs for Airlines and Passengers

Passenger Protections Requirements Are More Extensive in the EU than in the United States or Canada

Passenger protections requirements for flight delays, cancellations, and denied boarding are overall more extensive in the EU than they are in the United States or Canada. While all three regions have enhanced passenger protections in recent years, EU care and compensation guarantees are generally more extensive than those in the United States or Canada. (Table 3 summarizes what airlines are required to provide passengers for flight delays, cancellations, and denied boardings in the three regions.) In April 2011, U.S. DOT further enhanced its airline passenger protections by, among other things, increasing financial compensation in the event of an involuntary denied boarding. The Canadian Minister of Transport, Infrastructure and Communities launched "Flight Rights Canada" in September 2008 to increase air passenger's awareness of their rights, which includes a voluntary "Code of Conduct of Canada's Airlines" which, among other things, recommends Canadian airlines adopt specific provisions related to flight disruptions in their contracts of carriage.[67] In the EU, a regulation enacted in 2004 entitles passengers to care and compensation, under specific circumstances, for

[66]For example, weather events and ground delay programs at either the origin or destination airport were associated with a greater incidence of cancellation. Much like previous academic work on cancellations, our results also showed that the likelihood of cancellation decreases as the length of the flight increases.

[67]As discussed later in this report, all four of Canada's major airlines have added these provisions to their contracts of carriage in response to this initiative.

all three types of disruptions.[68] Officials from the European Commission (Commission) told us that these rules harmonized levels of customer service across all EU member states and airlines, ensuring that passengers can expect to be cared for and compensated if their flight is canceled or seriously delayed or if the passenger is denied boarding. Before the current regulation was put into place, according to these European officials, some airlines were increasingly overbooking flights, while providing little care or compensation to those inconvenienced passengers who were denied boarding. The officials said that the goal of the regulation was not to punish airlines for delays or cancellations, or even necessarily reduce the number of disruptions, but rather to make passengers "whole" when flights are disrupted.

Table 3: Comparison of Governmental Requirements in the United States, Canada, and the EU of Benefits Provided to Passengers by Airlines during Flight Disruptions

Flight disruption	United States	Canada	EU
Delay	No federal requirements for care or compensation[a]	No requirements for care or compensation	• Passengers on flights delayed 2 or more hours from departure (dependent on flight distance) entitled to care, including, meals, refreshments, communication services, and, in certain cases, hotel accommodations[b] • Passengers on flights delayed more than 5 hours, entitled to reimbursement in part or in full, dependent upon circumstances,[c] and a return flight to the first point of departure, at the earliest opportunity if they decide to pursue their journey[d]

[68]Regulation (EC) 261/2004, 2004 O.J. (L 46/1).

Flight disruption	United States	Canada	EU
Cancellation	Refund for unused portion of ticket[e]	No requirements for care or compensation	Passenger care: • Passengers may be entitled to care, such as meals, refreshments, communication services, and, in certain cases, hotel accommodations[f] • Passengers entitled to the choice between rerouting or reimbursement[g] Passenger compensation:[h] • €250 for flights 1,500 kilometers (km)[i] or less • €400 for all intra-community flights more than 1,500 km and all other flights between 1,500 km and 3,500 km • €600 for all other flights • May be reduced by 50% if rerouted to destination within certain time frames[j]
Denied boarding	Passenger compensation:[k] • 200% of the fare (up to $650) if transported to the final destination (or first stopover, if one) more than 1 hour but less than 2 hours (or more than 1 hour but less than 4 for international flights) of scheduled arrival • 400% of the fare (up to $1,300) if transported to the final destination (or first stopover, if one) 2 hours or more (or 4 hours or more for international flights) after the planned arrival time of the original flight[l]	No requirements for care or compensation	Passenger care: • Passenger entitled to care, including, meals, refreshments, communication services, and, in certain cases, hotel accommodations[m] Passenger compensation:[n] • €250 for flights 1,500 km or less • €400 for all intra-community flights more than 1,500 km and all other flights between 1,500 km and 3,500 km • €600 for all other flights • May be reduced by 50 percent if rerouted to destination within certain time frames[o]

Source: GAO analysis of laws and regulations.

[a]According to DOT, passengers who experience an extensive delay are entitled to the same benefits as those who experience a cancellation, however, DOT has not defined what constitutes an "extensive" delay. In instances of tarmac delays, adequate food and potable water must be provided no later than 2 hours after the aircraft leaves the gate (or touches down, in the case of an arrival).

[b]Passengers will be entitled to hotel accommodations if the reasonable expected time of departure is at least the day after the time of departure previously announced. Regulation (EC) 261/2004, art. 9, 2004 O.J. (L 46/1). *See* also Id., art. 6(1). *But see,* infra, C-402/07 and C-432/07, *Sturgeon v. Condor Flugdienst GmbH Böck, Lepuschitz v. Air France SA*, 2009 E.C.R. I-10923.

[c]Regulation (EC) 261/2004, art. 6(1)(iii), 2004 O.J. (L 46/1). *See also* Id., art. 8(1)(a).

[d]Id., art. 6(1)(iii). *See also* Id., art. 8(1)(a).

[e]According to DOT, airlines do not owe refunds to passengers who accept and travel alternate routes to their destinations.

[f]Regulation (EC) 261/2004, art. 5(1)(b), 2004 O.J. (L 46/1). See also Id., art. 9.

[g]Id., articles 5(1)(a), 8. *See also* Id., art. 8.

[h]Id., article 5(1)(c). *See also* Id., art. 7(1).

[i]In determining distance, the basis shall be the last destination at which the denial of boarding or cancellation will delay the passenger's arrival after the scheduled time. Regulation (EC) 261/2004, art. 7(1), 2004 O.J. (L 46/1).

[j]Id., art. 7(2).

[k]14 C.F.R. § 250.5. On April 25, 2011, DOT issued its final rule on Enhancing Air Passenger Protections, which, as of August, 23, 2011, increased the denied boarding compensation limits to what is listed above, implemented an automatic inflation adjuster for minimum denied boarding compensation limits every two years, and clarified the application of the rule and requirements imposed on airlines in this regard, among other things. 76 Fed. Reg. 23110 (Apr. 25, 2011).

[l]Pasengers are not entitled to compensation if the airline offers alternate transportation that is planned to arrive at the passenger's destination or first stopover not later than 1 hour after the planned arrival time of the passenger's original flight. 14 C.F.R. § 250.5.

[m]Regulation (EC) 261/2004, art. 4(3), 2004 O.J. (L 46/1). *See also* Id., art. 9.

[n]Id., art. 4(3). *See also* Id., art. 7(1).

[o]Id., art. 7(2).

In the event of a flight delay, the EU regulation requires that airlines offer passengers care and, under certain circumstances, the option of reimbursement or a return flight to the first point of departure, while there are no U.S. and Canadian requirements with similar levels of care or compensation.[69] Under EU regulation, when a flight is delayed at least 2, but less than 5 hours (depending on the distance of the flight), airlines are required to provide passengers with certain types of care, including meals and communication services, and if the delay requires an overnight stay passengers must be offered hotel accommodations and transportation between the airport and hotel.[70] Furthermore, if the delay is at least 5 hours, passengers must also be offered reimbursement for the unused portion of their ticket (and for the part of the journey already made if the flight no longer serves its original purpose) and, if necessary, a return

[69]Regulation (EC) 261/2004 applies to the following: (1) all flights departing an EU signatory member states' airport (regardless of the destination) and (2) all EU airline flights departing outside the EU (a third country) into the EU unless the country of departure has provided benefits or compensation or assistance. Regulation (EC) 261/2004, art. 3, 2004 O.J. (L 46/1). This regulation applies to operating airlines, but the liability falls upon the airline which is contractually obligated to the passenger. Under article (3)(5), when an operating airline which has no contract with the passenger performs obligations under this regulation, it shall be regarded as doing so on behalf of the person having a contract with that passenger.

[70]Regulation (EC) 261/2004, articles 6 and 9, 2004 O.J. (L 46/1). According to a recent European Commission report of delay data voluntarily provided by airlines, on average, less than 1.2 percent of all flights departing from and arriving in the EU between 2006 and 2009 potentially fall under the scope of their passenger protections regarding long delays (i.e., where flights are delayed by at least 2 hours).

flight to the point of departure.[71] They must also be given written notice of the rules for care and compensation.[72] By comparison, passengers on delayed flights in the United States and Canada are not entitled to care or compensation by law.[73]

In the EU, when a flight is canceled, the EU regulation requires that passengers receive care in certain circumstances, compensation, and the option of being rerouted or reimbursed (with a return flight to the point of departure), while passengers in the United States and Canada do not have such extensive rights. Passengers on canceled flights covered by the EU regulation are entitled to the same rights as those passengers on delayed flights (as described previously) and, additionally must be offered the choice between being rerouted[74] or reimbursed for part or all of their ticket, depending on the circumstances along with a return flight to the first point of departure at the earliest opportunity.[75] In addition,

[71]Regulation (EC) 261/2004, articles 6(1)(iii) and 8(1)(a), 2004 O.J. (L 46/1). *But see, infra,* C-402/07 and C-432/07, *Sturgeon v. Condor Flugdienst GmbH Böck, Lepuschitz v. Air France SA*, 2009 E.C.R. I-10923.

[72]Regulation (EC) 261/2004, art. 14, 2004 O.J. (L 46/1).

[73]As mentioned earlier, passengers who experience a long delay on the airport tarmac in the United States are entitled to certain care, such as food and water no later than 2 hours, and the assurance a plane will not remain on the tarmac greater than 3 hours. 14 C.F.R. part 259. Additionally, the Montreal Convention may also be applicable when international passengers are delayed, allowing passengers to take legal action against an airline for damages. Convention for the Unification of Certain Rules for International Carriage by Air (Montreal Convention), ch.3, art. 19, May 28, 1999 (entered into force on Nov. 4, 2003), *reprinted in* S. Treaty Doc. No.106–45. Furthermore, Canadian airlines are required to address the "failure to operate on schedule" in their contract of carriage. Air Transportation Regulations SOR/88-58, Part V, Div. I, § 107(1)(n)(vi) (Can). Finally, DOT officials told us that they can, in certain circumstances, take enforcement actions and issue fines against airlines unless the airline provides passengers with refunds after cancellations and extensive delays.

[74]Rerouting shall be provided under comparable transport conditions, to the passenger's final destination at the earliest opportunity; or, under comparable transport conditions, to the passenger's final destination at a later date at the passenger's convenience, subject to the availability of seats. Regulation (EC) 261/2004, art. 8, 2004 O.J. (L 46/1). The rerouting does not necessarily need to be operated by the airline the passenger booked with. See, Information Document of the Directorate-General for Energy and Transport: Answers to Questions on the Application of Regulation (EC) 261/2004, February 17, 2008.

[75]Regulation (EC) 261/2004, articles 5 and 8, 2004 O.J. (L 46/1). Reimbursement must be within seven days and must provide the full cost of the ticket at the price at which it was bought, for the part(s) of the journey not made, and for the part(s) of the journey made if the flight is no longer serving any purpose in relation to the passenger's original travel plans. Regulation (EC) 261/2004, art. 8(1)(a), 2004 O.J. (L 46/1).

passengers on such flights are entitled to financial compensation, the amount of which depends on the length of the canceled flight and may be reduced by 50 percent if the passenger is rerouted, under certain circumstances.[76] An airline may be exempt from the obligation to pay compensation if it can prove the cancellation was caused by an extraordinary circumstance that could not have been avoided even if all reasonable measures had been taken.[77] At the time a flight is canceled, the airline must provide passengers written notice of the rules for compensation and assistance.[78] By contrast, U.S. rules do not require care and compensation in the event of a cancellation, but do, require airlines to offer passengers a refund if they do not wish to accept and travel alternative routes to their destinations.[79] In Canada, passengers are not entitled to care or compensation in the event of a cancellation, nor is there a specific requirement that an airline refund a passenger their ticket price, in whole or in part.[80]

If a passenger is involuntarily denied boarding—generally because an airline has oversold seats on a flight and cannot find enough volunteers willing to take another flight—the passenger may be entitled to benefits, depending on the region. Passengers on flights covered by the EU

[76]The operator may reduce the compensation by 50 percent if the arrival time on the reroute does not exceed the originally scheduled arrival time by (1) 2 hours for all flights 1,500 kilometers (km) or less, (2) by 3 hours for all intra-community flights more than 1,500 km and all other flights between 1,500 km and 3,500 km, and (3) by 4 hours for all other flights. Regulation (EC) 261/2004, art. 7(2), 2004 O.J. (L 46/1).

[77]Regulation (EC) 261/2004, art. 5(3), 2004 O.J. (L 46/1). *See also* C-549/07, *Wallentin-Herman v. Alitalia—Linee Aeree Italiane SpA*, 2007 E.C.R. I-nyr.

[78]Regulation (EC) 261/2004, art. 14, 2004 O.J. (L 46/1). According to a recent Commission report of delay data voluntarily provided by airlines, on average, about 0.5 percent of scheduled flights in Europe between 2006 and 2009 were canceled and potentially fall under the scope of their passenger protections regarding cancellations.

[79]Consumers have a private right of action for refunds under the Consumer Credit Protection Act, 15 U.S.C. § 1601 et seq.; DOT has codified these requirements at 14 C.F.R. part 374. Additionally, according to officials at DOT, it can take enforcement action against airlines, under 49 U.S.C. § 41712, for the refusal to issue refunds for the purchase price of a ticket, within a certain number of days, to passengers who wish to cancel their trip as a result of a flight cancellation or significant schedule change (for example, flight delay).

[80]Cancellations and refund policies, however, are required to be addressed in an airline's contract of carriage. Air Transportation Regulations SOR/88-58, Part V, Div. I, § 107(1)(n)(vi), (vii), 122(c) (Can).

regulation have a right to care and financial compensation. Comparatively, passengers covered under U.S. regulations are entitled to financial compensation and passengers in Canada are entitled to neither care nor compensation except as provided under their contracts of carriage.[81] To limit the number of passengers who are involuntarily denied boarding when a flight is oversold, airlines in the United States and the EU are required to first request volunteers to relinquish their confirmed space in exchange for benefits, such as credit for future travel, before selecting passengers for denied boarding.[82] When selecting passengers for denied boarding, U.S. airlines are required to use boarding priority rules that are in compliance with DOT regulations.[83] Under both U.S. and EU requirements, those passengers selected for denied boarding must be offered financial compensation.[84] Passengers in the EU also are guaranteed the same care offered to passengers whose flights are delayed or canceled and must also be offered the option of

[81]Canadian regulations require airlines to set forth policies related to compensation for denial of boarding in their contracts of carriage. Air Transportation Regulations SOR/88-58, Part V, Div. I, § 107(1)(n)(iii), (vii), 122(c) (Can).

[82]14 C.F.R. § 250.2b; Regulation (EC) 261/2004, art. 4, 2004 O.J. (L 46/1). Under the EU regulation, passengers who volunteer to surrender their reservations must also be offered the choice between reimbursement and a return flight to the first point of departure or rerouting to their final destination at the earliest opportunity.

[83]Boarding priority factors may include, but are not limited to, the following: a passenger's time of check-in, whether a passenger has a seat assignment before reaching the gate for airlines that assign seats, the fare paid by a passenger, a passenger's frequent flyer status, and a passenger's disability or status as an unaccompanied minor. 14 C.F.R. § 250.3.

[84]The factors that determine the amount of financial compensation are different in the EU and the U.S. In the EU, compensation depends on the time passengers reach their final destination after being re-routed and the distance of the flight, and in the United States, it depends on the time passengers are re-routed and whether it is a domestic or international flight. Regulation (EC) 261/2004, articles 4 and 7, 2004 O.J. (L 46/1); 14 C.F.R. § 250.5. Passengers who are involuntarily denied boarding will not be entitled to compensation if they are offered alternative transportation that, at the time the arrangement is made, is planned to arrive at the first stop-over, or if none, the final destination, not later than 1 hour after the original flight's arrival time. U.S. airlines may offer free or reduced rate air transportation in lieu of cash if the value is equal to or greater than the cash payment otherwise required and the airline informs the passenger of the amount of cash compensation that would otherwise be due and that the passenger may decline the transportation benefit and receive the cash payment. 14 C.F.R. § 250.5(b). Additionally, in accordance with DOT's Final Rule on Enhancing Airline Passenger Protections, as of August 23, 2011, the airline must also disclose all material restrictions on airline travel vouchers that may apply. 76 Fed. Reg. 23110 (Apr. 25, 2011), at 49 C.F.R. § 250.5(c)(3).

reimbursement, in whole or in part, dependent upon the circumstances, and a return flight to the first point of departure or rerouting the final destination.[85] In both regions, airlines must notify passengers in writing of their rights.[86]

Some airlines in the United States and Canada, as described earlier, voluntarily include provisions in their contracts of carriage for care and compensation beyond what is legally required for delays, cancellations, and denied boarding. These provisions are enforceable as a legal contract between the airline and the ticket holder. The airlines we spoke with in the EU do not include any additional care or compensation beyond the EU requirements discussed previously and the EU regulation does not require airlines to include those requirements in their contracts of carriage. We examined the contracts of the seven largest airlines in the United States and found that five of these airlines may, in certain circumstances, provide certain types of care, such as meal vouchers and free phone calls, for delays and cancellations that extend beyond a certain time (see table 4). Certain airlines also state in their contracts of carriage that they must also provide hotel accommodations and ground transportation, under certain circumstances, when an overnight stay is required. The circumstances under which airlines provide these amenities vary and may depend on a number of factors, such as the cause, length, and timing of the flight disruption. All four of Canada's major airlines have added passenger protections for delays, cancellations, and denied boarding in response to the 2008 federal government initiative mentioned above, according to airline officials in Canada. Although airlines are not required to adhere to passenger protection provisions outlined in the initiative's Code of Conduct, because all four of Canada's major airlines have added its provisions to their contracts of carriage, these become part of the binding contract between the airline and the passenger.[87] As a result, these airlines now guarantee in their contracts of carriage that they

[85]Regulation (EC) 261/2004, articles 8 and 9, 2004 O.J. (L 46/1).

[86]Regulation (EC) 261/2004, art. 14, 2004 O.J. (L 46/1); 14 C.F.R. § 250.9. Additionally, in accordance with DOT's Final Rule on Enhancing Airline Passenger Protections, as of August 23, 2011, the airline must also provide verbal notification of such rights. 76 Fed. Reg. 23110 (Apr. 25, 2011). Furthermore, although not required, the four major Canadian airlines include in their contracts of carriage similar denied boarding procedures as in the United States and the EU.

[87]Officials from the Canadian Transportation Agency identified the four major Canadian airlines as Air Canada, WestJet, Air Transat, and Air Canada Jazz.

will provide passengers with a meal voucher if a flight delay exceeds 4 hours, as well as hotel accommodations and ground transportation if a flight delay exceeds 8 hours and requires an overnight stay. If a flight is canceled or a passenger is denied boarding, the airlines will rebook passengers or refund the unused portion of the ticket.[88] Flight Rights Canada's Code of Conduct does not make the airline responsible for acts of nature or the acts of third parties.

Table 4: Comparison of Contract of Benefits That May be Provided Under Domestic Carriage Provisions for Flight Delays and Cancellations for Selected U.S. Airlines, as of June 2011

	Options for transporting passengers		Amenities provided to passengers			
Airline	Rebook on next available flight offered by the airline	Rebook on a flight offered by another airline	Meals and/or snacks	Hotel accommodation and/or ground transportation	Phone calls	Credit for future travel
Alaska Airlines	✓	✓		✓	✓	✓[a]
American Airlines	✓	✓		✓[b]		
Delta Air Lines	✓	✓	✓	✓		
JetBlue Airways	✓		✓	✓		✓[a]
Southwest Airlines	✓					
United Airlines	✓	✓		✓[b]		
US Airways	✓	✓				

Source: GAO analysis of airline contracts of carriage as of June 2011.

[88]The Code of Conduct also specifies that airlines should provide refreshments to passengers who experience a delay while on the tarmac, if it is safe, practical, and timely to do so, and the option to deplane after 90 minutes if circumstances permit.

Note: We selected these airlines from the 10 largest U.S. airlines using FAA's data on airline available seat miles from the last 12 months for which data were available. Available seat miles are calculated by multiplying aircraft miles flown in inter-airport flights by the number of seats available for revenue passenger use on those flights. Although AirTran Airways and Continental Airlines were among the 10 largest U.S. airlines, we did not include them in this analysis because they have recently merged with Southwest Airlines and United Airways, respectively, and therefore we expect that these airlines will refer to the contract of carriage of their purchasing airline. We also did not include SkyWest because it follows the policies of the airline partner that tickets its flights. SkyWest partners with AirTran Airways, Delta Air Lines, and United Airlines. This table does not include provisions that are required by law to be provided in the event of a lengthy tarmac delay, and also excludes provisions for refunds. The options for transportation and amenities offered to passengers vary by airline and by circumstances. For example, some airlines offer these services to passengers only when the airline is the cause of the flight disruption and airlines differ by the amount of time a delay and cancellation must exceed before providing passengers with amenities.

[a]For flight delays that exceed 2 hours, Alaska Airlines offers passengers 2,000 Mileage Plan Bonus Miles. JetBlue offers passengers a $50 credit for future travel when its flights are canceled due to a controllable irregularity within 4 hours of the scheduled departure time. JetBlue passengers are also entitled to credit when their flight is delayed due to a controllable irregularity: $25 if the delay is greater than 1 hour but less than 2 hours, $50 if the delay is greater than 2 hours but less than 4 hours, credit equal to the one-way trip fare if the delay is greater than 5 hours but less than 6 hours, and credit equal to the roundtrip fare if the delay is greater than 6 hours.

[b]American Airlines provides hotel accommodation if the delay or cancellation was caused by events within the airline's control and United Airlines provides hotel accommodations in the event of a flight diversion.

Passenger Protections May Increase Costs for Airlines and Passengers

Care and compensation requirements provide protections and benefits for passengers whose flights are disrupted, but they also increase costs to airlines and could increase passengers' fares. Airline officials we spoke with in the EU and the United States maintained that passenger protections increase their costs, though they did not provide documentation of specific cost increases because they consider the information to be confidential.[89] While data from airlines on these costs are unavailable, a February 2010 study of the EU passenger protection requirements noted that airlines the study authors spoke with reported the cost of compliance for EU airlines ranges from 0.1 to 0.5 percent of airlines' annual revenue.[90] However, officials from one European airline, as well as officials from an airline association, maintained that airlines' cost of compliance exceeds this estimate. Increases in required compensation for passengers denied boarding have also increased costs for both U.S. and EU airlines, according to airline officials we spoke with. In the United States, officials with some U.S. airlines told us that

[89]Additionally, several airline officials told us that they do not document their overall costs for complying with passenger service requirements.

[90]Steer Davies Gleave, *Evaluation of Regulation 261/2004,* European Commission, Directorate-General Energy and Transport (London, UK, February 2010).

complying with the requirements to better inform passengers about routinely delayed and canceled flights and to post information such as flight on-time performance data on airline Web sites costs hundreds of thousands of dollars. Officials with one of these airlines estimated that airline personnel spent about 3 months adding the information at the airline's Web site. Some airlines in the United States and the EU told us that compliance costs such as these can lead to higher fares. However, it is very difficult to isolate the impact of compliance on fares because they are set based on demand in competitive markets as well as other factors.[91]

Passenger protections can create financial burdens on airlines for major events outside their control. For example, as noted above, airlines subject to EU regulations are required to provide certain care in the event of a delay or cancellation, regardless of whether the disruption was within the airline's control. These regulations require an airline to provide passengers with food, lodging, and other care, dependent on the circumstances, during short-term disruptions in travel plans. However, when major disruptions to the airspace system occur, this requirement can obligate airlines to provide passengers with lodging and other care for extended periods of time at great cost.[92] Such a situation occurred in 2010 when the European air transport industry was significantly affected by the consequences of the Eyjafjallajökull volcanic eruption in Iceland. The volcano, which erupted on April 14, 2010, created a cloud of volcanic ash that drifted through large sections of European airspace. Volcanic ash contains substances that may harm aircraft, so national authorities decided to close affected airspace. As a result, more than 100,000 flights were canceled and millions of passengers were unable to fly. In many cases, the passengers were stranded in a foreign country without any immediate possibility to go back home. Representatives of one EU airline

[91]See GAO, *Airline Deregulation: Reregulating the Airline Industry Would Likely Reverse Consumer Benefits and Not Save Airline Pensions*, GAO-06-630 (Washington, D.C.: June 9, 2006).

[92]During the last 5 years, flight cancellations have generally been less frequent in the EU than in the United States. According to Commission estimates, flight cancellations comprised about 0.5 percent of all flights in Europe from 2006 through 2009. According to DOT data, canceled flights in the United States ranged from about 1.4 percent to 2.1 percent of U.S. flights during the same period. The EC reported that flight cancellations in Europe increased to about 2.3 percent of all flights during 2010 primarily because of unfavorable flight conditions caused by the eruption of the Eyjafjallajökull volcano in Iceland.

told us that when the eruption occurred, they booked more than 100,000 hotel rooms for their scheduled passengers and eventually chartered aircraft to get passengers to their destinations. The airline's representatives estimated that the incident cost the airline about $4.5 million. Major disruptions generally result from unsafe flying conditions. According to airline officials in both the United States and EU, the possibility of large monetary claims as a result of such incidents could pressure airlines to operate in conditions they would otherwise deem unsafe for flight in order to avoid high costs, but according to Commission officials there are no available data on the existence or extent of this issue.

While increasing the compensation for denied boarding will increase airline's costs if airlines don't change their booking policies, reducing overbooking reduces revenues because fewer seats can be sold, according to airlines officials we interviewed. Overbooking is a revenue-producing strategy for many airlines, without which some would raise fares to offset their losses.[93] Additionally, airline officials said that reductions in overbooking could also limit the flexibility of passengers when choosing flights, as seat availability would be reduced and airline policies governing how and when passengers change their flights could become more restrictive. However, we found little evidence that increases in denied boarding compensation in the United States resulted in reduced overbooking. According to airline officials we spoke with, the 2008 compensation increase in the United States was not large enough to cause airlines to reduce their overbooking of flights.[94] Additionally, from 2004 through 2010, the number of voluntary denied boardings in the United States was less than 0.1 percent of all U.S. passengers boarded annually, while the number of involuntary denied boardings rose slightly but remained rare in relation to the total number of U.S. passengers, at 0.01 percent of all U.S. passengers (see fig. 9). In contrast, EU denied boarding compensation, though in some cases less than U.S. levels, has

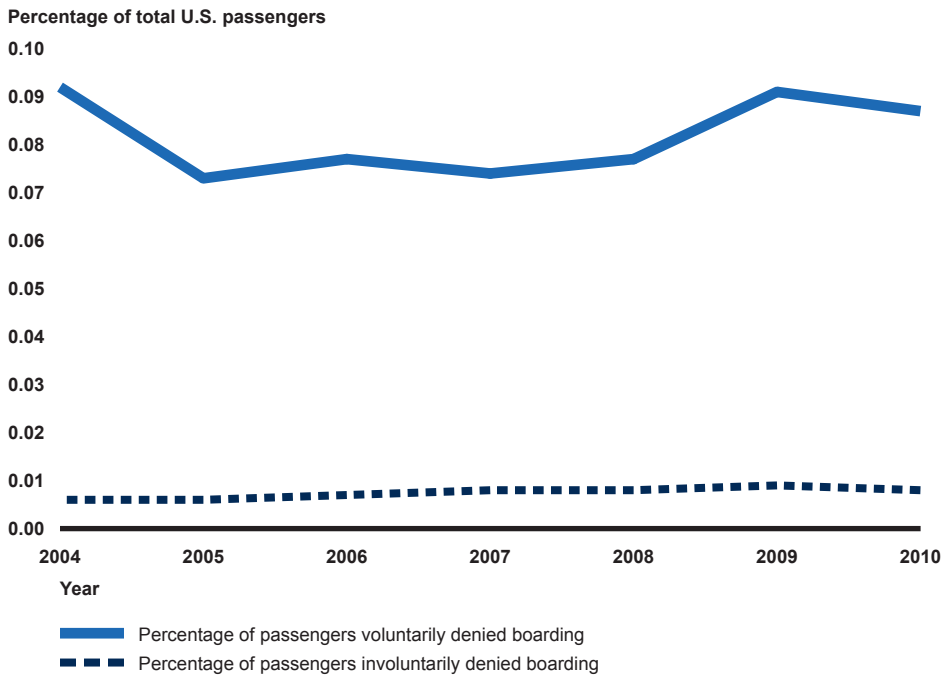
[93]Increases in required compensation for passengers involuntarily denied boarding could motivate airlines to be more aggressive when seeking volunteers for denied boarding, such as increasing the value of vouchers offered to passengers that willingly deplane, since they may be able to offer these volunteers compensation that is less than the amount required for passengers involuntarily denied boarding.

[94]Officials of one low-cost U.S. airline, though, did tell us that the cost associated with the 2008 increase in denied boarding compensation forced the airline to reduce overbooking levels by approximately 25 percent.

been significant enough to cause at least two EU airlines to reduce overbooking of flights, according to officials from these airlines.[95] According to these officials, this reduction in overbooking has adversely affected consumers through higher average ticket costs designed to offset the increased number of unused seats on each flight. However, data showing whether any such reductions in overbooking have caused EU airlines to increase their fares are not available.

[95]Prior to implementation of the current EU requirements (Regulation (EC) 261/2004), EU law required airlines to provide passengers denied boarding on flights of 3,500 kilometers or less with 150 euros and passengers denied boarding on flights of more than 3,500 kilometers with 300 euros. Regulation (EC) 261/2004 increased the required denied boarding compensation to 250 euros for flights of 1,500 kilometers or less, 400 euros for flights of more than 1,500 kilometers but less than 3,500 kilometers, and 600 euros for flights of more than 3,500 kilometers.

Figure 10: Voluntary and Involuntary Denied Boardings in the United States as a Percentage of Total Passengers, Calendar Years 2004–2010



Source: GAO analysis of DOT data.

Note: This figure reflects data from airlines with at least 1 percent of total domestic scheduled passenger service revenue.

Enforcing Passenger Protections Can Create Challenges

Extensive passenger protections, while providing benefits and guarantees to passengers, can create challenges for the government entities responsible for enforcing the requirements and for passengers in obtaining benefits due to them. These challenges include difficulties enforcing unclear requirements and ineffective passenger complaint processes. Such challenges can limit the potential for the requirements to mitigate hardships for airline passengers.

Government enforcement bodies in each region are responsible for ensuring that airlines comply with their region's requirements. DOT and the Canadian Transportation Agency (CTA) serve as the enforcement bodies for the United States and Canada, respectively. In the EU, each of its 27 member states, and other countries that joined the EU aviation market (such as Iceland, Norway, and Switzerland), establishes its own

body responsible for enforcing the EU regulation, which is typically the agency responsible for aviation oversight. These enforcement bodies use similar activities to monitor airline compliance, including investigating passenger complaints and issuing penalties against airlines for noncompliance. Enforcement bodies in each region receive passenger complaints or information (for example, through a media report) about a possible violation of passenger protections and decide whether to investigate.[96] DOT officials told us they will investigate any case alleging a violation of a DOT rule, but will generally only pursue an enforcement action against airlines if they discover a pattern or practice of violations or the incident is particularly egregious. CTA officials and an enforcement body official from one EU member state told us they investigate and may pursue enforcement actions against an airline based on an individual's complaint.[97] If officials determine that an airline has violated passenger protections, they may fine the airline, depending on the region or the member state.[98] In addition to conducting investigations based on passenger complaints, enforcement bodies in each region initiate investigations. For example, DOT officials told us they routinely investigate each major airline and their investigations have resulted in the collection of fines.[99] In two EU member states, officials from the

[96]Officials from enforcement bodies we spoke with in all three regions told us they attempt to resolve passenger complaints with the airline informally before conducting a formal investigation.

[97]DOT officials told us that they closed 717 passenger complaint cases in 2009 and 828 cases in 2010. As of May 26, 2011, they have closed 328 cases and 454 cases remain open. In 2009–2010, CTA received a total of 642 air travel complaints for processing through its dispute resolution processes, 599 for informal facilitation and 43 for formal adjudication.

[98]Officials at the CTA told us that enforcement staff can impose financial penalties against an airline or take administrative actions against the airline, including issuing formal reprimands, cease and desist orders, license suspensions, and license cancellations. CTA can also order an airline to modify their contract of carriage and if the airline has failed to apply its contract of carriage correctly, they can award a passenger their out-of-pocket expenses as a result of the airline's failure to apply the contract of carriage. They may also order appropriate corrective measures pursuant to regulation. Air Transportation Regulations SOR/88-58, Part V, Div. II, § 113.1(a) (Can).

[99]According to DOT officials, these proactive investigations began in 2008 and involve on-site examination of airlines' compliance with DOT's air travel consumer protection regulations covering advertising, refunds, carriage of passengers with disabilities, baggage, and oversales, as well as to review the airline's customer service commitments and manuals and training materials relevant to DOT's consumer protection requirements. DOT officials said they conduct about six such investigations each year.

enforcement bodies told us they visit airports to see if airlines are displaying required information about passenger protections, but have not issued fines.

Lack of Clarity in Regulations and Confusion in Application

The first challenge to the effective application of passenger protections arises when there is a lack of clarity in regulations. In the EU, where passenger protection regulations are more extensive than in the United States or Canada, officials from the Commission told us that different interpretations of these regulations by enforcement bodies in different member states have made it challenging to ensure successful implementation of the regulation. A 2010 study for the Commission about the impact of the EU passenger protection regulation found that more needs to be done to ensure that passengers' rights are properly protected.[100] In particular, the study noted that in some areas the rights granted by the regulation can lead to different understandings. The Commission also recently reported that "the novelty of some provisions of the Regulation has led to different interpretations, and thus varied application, among airlines and national enforcement authorities, rendering it difficult for passengers and stakeholders to understand the scope and limits of the rights set out."[101] Stakeholders told us, for example, that the following two provisions were unclear and confusing to implement, respectively:

- *Unclear definition of extraordinary circumstances.* According to some airlines, airline associations, and consumer groups we spoke with in the EU, the definition of this term—which refers to situations in which airlines are exempt from the passenger compensation requirement when a flight is canceled—has left room for confusion.[102] A recent ruling by the European Court of Justice (ECJ) provided some

[100]Steer Davies Gleave, *Evaluation of Regulation 261/2004*.

[101]European Commission, *Communication From the Commission to the European Parliament and the Council* (April 2011).

[102]"Extraordinary circumstance" is not defined in Regulation (EC) 261/2004. The regulation exempts an airline from the obligation to pay compensation in the event of a cancellation if the airline can prove that the cancellation is caused by extraordinary circumstances that could not have been avoided even if all reasonable measures had been taken. Regulation (EC) 261/2004, art. 5(3), 2004 O.J. (L 46/1). In *Wallentin-Herman*, the ECJ defined extraordinary circumstances as events which by their nature are not inherent in the normal exercise of the activity of the airline and are beyond its actual control. *Wallentin-Herman v. Alitalia—Linee Aeree Italiane SpA*, 2007 E.C.R. I-nyr.

clarification for enforcement bodies when it ruled that technical issues, such as an airplane malfunction, may constitute an extraordinary circumstance only when these issues stem from events outside the normal activities of the airline and are beyond its control.[103] Even so, some enforcement bodies are interpreting this ruling differently. For example, officials from one enforcement body told us that even if a technical issue is routine, they may still consider it an extraordinary circumstance if they believe the safety risks were too great, whereas other enforcement bodies in the EU have interpreted the ECJ's ruling more strictly.

Additionally, some stakeholders that we spoke with told us that the extraordinary circumstance provision in the regulation should be revised to restrict the amount of assistance an airline must provide to passengers or to identify an extensive list of scenarios under which the airline would be exempt from the passenger compensation requirement. For example, officials from an airline and an airline association told us that they believe the regulation should be amended to exempt airlines from paying for weeks of hotel accommodations and food (not just compensation) in response to major disruptions, such as the Eyjafjallajökull volcanic eruption. In a recent report, the Commision stated this incident illustrated the structural limits of the regulation and that the "proportionality of some current measures, like the unlimited liability regarding the right to care under major natural disaster, may merit assessment."

- *Confusion over definition of delay.* Uncertainty about when compensation is required for delays and cancellations has also created enforcement challenges. In the EU, a November 2009 ruling of the ECJ specified that passengers whose flights are delayed more than 3 hours experience the same inconvenience as those whose flights are canceled and therefore both should be entitled to the same financial compensation payments from airlines.[104] This ruling created confusion in member states and within the industry as to when to compensate passengers who have been delayed. Airline and some airline association officials told us that this ruling contradicts the text of

[103] *Wallentin-Herman v. Alitalia–Linee Aeree Italiane SpA*, 2007 E.C.R. I-nyr.

[104] *Sturgeon v. Condor Flugdienst GmbH Böck, Lepuschitz v. Air France SA*, 2009 E.C.R. I-10923.

the regulation, which, requires reimbursement (in part or in full), not compensation, in the event of a delay of more than 5 hours. In the United Kingdom (UK), according to Commission officials, the International Air Transport Association, among others, filed a suit in the UK Court of Justice against the UK's enforcement body's policy to compensate passengers in line with the ECJ ruling.[105] An official from the UK's enforcement body told us that the UK Court of Justice submitted questions of law stemming from this case to the ECJ and until the ECJ responds with further clarification, the enforcement body has suspended all investigations into complaints on the topic.[106] Uncertainties over these provisions may make it difficult for airlines and passengers to know when an airline must compensate its passengers.

The challenges arising from the lack of clarity pertaining to passenger protection regulations, such as the confusion about the definition of delay, can be exacerbated when the EU requirement is applied unevenly across jurisdictions. For instance, the enforcement of EU regulations has been complicated because member states have flexibility in structuring their enforcement to account for differences in their national laws and policies.[107] As a result, enforcement bodies in the Netherlands and Germany, for example, use different sanction strategies for ensuring that the airlines comply with the regulation, resulting in varying types and amounts of penalties for airlines. In particular, the types of sanctions and amounts of sanctions these enforcement bodies can impose differ because of laws and policies specific to their member state. Officials from the Netherlands's enforcement body told us they can impose only reparatory sanctions, which prevents them from collecting a fine if the

[105] *TUI Travel Plc, British Airways Plc, Easyjet Airline Company Ltd and International Air Transport Association* v. *The Civil Aviation Authority*, Case CO/6569/2010.

[106] According to Commission officials, passengers in the UK may still submit a complaint related to the ECJ ruling through the court system.

[107] The Commission does strive to ensure that the application of EU regulations is harmonized so that passengers are provided with equal treatment across the EU. In order to create harmonization, the EU encourages enforcement bodies to discuss issues and standardize their practices through meetings and the development of voluntary agreements and issuance of Commission guidance. Additionally, the ECJ provides uniform and authoritative interpretations of EU legislation to ensure that they are applied in the same way in all EU member states. Ultimately, though, member states are given latitude in their enforcement practices.

airline makes amends with the passenger, while the enforcement body in Germany can issue repressive sanctions, which can be imposed regardless of whether the airline makes amends with the passenger.[108] The amount of a sanction also differs between the two member states. For example, the Dutch enforcement officials told us that there is no set amount, but it must be reasonable and proportionate to the severity of the violation, while in Germany, officials from the enforcement body told us that the amount of a sanction is based on the seriousness of the complaint. Different national laws affect the circumstances in which sanctions can be issued. For example, the German officials told us that German law prohibits them from considering ECJ decisions, such as the ruling that passengers who are delayed more than 3 hours should receive the same compensation as those whose flights are canceled, and therefore the German enforcement body is not using the same standards as other enforcement bodies to sanction airlines.

Ineffective Passenger Complaint Process

The second challenge to the application of passenger protections arises when there is a lack of an effective passenger complaint process. The enforcement processes of the EU, as well as those of the United States and Canada, demonstrate challenges passengers can face obtaining benefits due to them. When passengers in the United States, Canada, or the EU do not receive benefits to which they believe they are entitled, they can submit a complaint to any or all of three entities: the airline, the national enforcement body, or the court system (see fig. 11). However, according to government officials, passengers in the United States and EU can receive financial compensation only through the airline or the court.[109] The enforcement bodies in these regions cannot award passenger compensation because their authority does not extend to

[108]Officials from the Netherlands's enforcement body told us that legislative changes made to national law (Aviation Act) were made in December 2009 to permit this body to impose repressive sanctions.

[109]In Canada, CTA can order an airline to pay out-of-pocket expenses to passengers if the airline has failed to apply the provisions in the contract of carriage. Passengers can also submit claims through an alternative dispute resolution (ADR) process in the EU, but this option is available in only four EU member states, the rulings are not always binding on the airline, and ADR staff may lack of expertise to handle cases, especially those related to extraordinary circumstances.

enforcing payment by the airlines.[110] The 2010 study for the Commission of the regulation reported inconsistent implementation and enforcement of the regulation across enforcement bodies and airlines.[111] According to the study, airlines and consumer groups reported that there are a number of difficulties associated with passengers in the EU seeking compensation in a court, including the costs, time burden, availability of small claims courts, and limits on amounts awarded.[112] In the EU, according to Commission officials, passengers may pay for legal assistance when pursuing compensation in the courts from a variety of sources, such as from a consumer protection organization. In some member states, passengers can also use the commercial claim service EU Claim, but passengers must pay for these services with a percentage of what they are awarded.[113] Officials from one consumer group told us that when barriers are imposed on passengers claiming their benefits for violations of their rights, airlines may not comply with applicable requirements. Furthermore, despite a number of EU government-sponsored campaigns to inform passengers of their rights, several EU stakeholders told us passengers may still not be aware of their rights and therefore may not submit complaints if they believe their rights have been violated.[114]

[110]Although DOT cannot adjudicate claims and make monetary awards, DOT officials noted that its enforcement staff periodically intervenes with airlines to obtain compensation for a passenger to which he or she is entitled. Additionally, according to DOT, it may obtain compensation for consumers through settlements of potential violations with airlines and may also insert such provisions into a consent order.

[111]An even more recent report announced that the Commission will work with the network of national enforcement bodies to agree on harmonized interpretation and enforcement of the regulation. In 2011 it will launch an Impact Assessment to assess the proportionality of the current measures in the light of experience and the costs of the regulation for stakeholders, with a view to propose further measures on Air Passenger Rights, including of a legislative nature, in 2012.

[112]Passengers can use the European small claims procedure (Regulation (EC) 861/2007, 2007 O.J. (L 199/1)), which Commission officials told us aims to accelerate the settlement of small cross-border disputes and is available to every resident in a member state.

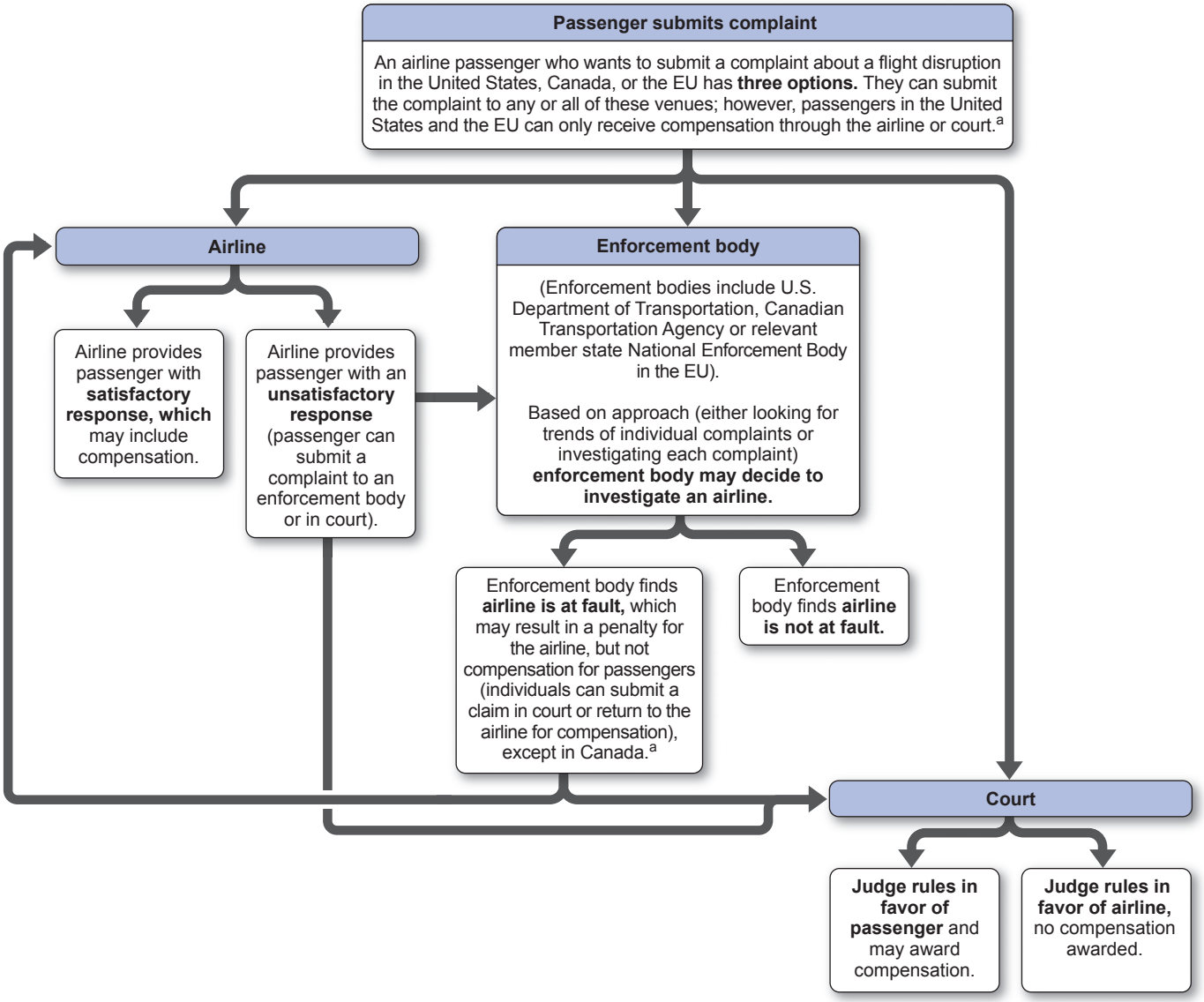
[113]EU Claim is a privately funded organization headquartered in the Netherlands. Based on flight data it has collected, EU Claim advises clients about the validity of their claims against airlines pursuant to Regulation (EC) 261/2004 and may choose to represent these clients before the airline and, if necessary, court. The fee for the organization's services is a percentage of any compensation awarded to the client.

[114]In 2009, the Netherlands collected about 750 passenger complaints, whereas Germany collected about 3,000. In Europe in 2009, a total of 35,198 complaints were received. The majority of these complaints (41 percent) were due to cancellations, and 25 percent were due to delays.

Additionally, officials from two consumer protection groups in the EU told us that some passengers may be confused about their rights under the EU regulation and some airlines may use that confusion to their advantage.[115]

[115]The Commission reported in 2011 that it will work with national enforcement bodies to promote a more uniform and quick handling of complaints as well as encourage airlines to establish reasonable and precise time frames for handling passenger claims.

Figure 11: Airline Passenger Complaint Process in the United States, Canada, and the EU



Source: GAO analysis.

[a]In Canada, if the enforcement body finds that an airline has failed to apply the provisions of its contract of carriage, it can require the airline to apply the relevant provisions and also award out-of-pocket expenses that were incurred by the passenger, according to officials from the CTA. They may also order appropriate corrective measures pursuant to regulation. Air Transportation Regulations SOR/88-58, Part V, Div. II, § 113.1(a) (Can). According to DOT, it may obtain compensation for consumers through settlements of potential violations with airlines and may also insert such provisions into a consent order.

Conclusions

Flight disruptions remain costly for passengers, airlines, and the economy. DOT has responded by enacting regulations to protect passengers in the event of tarmac delays and has enhanced involuntary denied boarding protections. DOT's tarmac delay rule has eliminated delays greater than 4 hours and nearly eliminated tarmac delays of more than 3 hours, thereby benefiting tens of thousands of passengers. Increased compensation for involuntary denied boardings provides for passengers in the event they are bumped from their reserved flight.

Although DOT's rules have benefited some passengers, DOT's current flight performance data may not fully inform consumers of airlines' quality of service as intended. By collecting data only from the largest airlines, DOT does not obtain and therefore cannot provide consumers with a complete picture of flight performance, particularly at airports in rural communities or among smaller airlines. Accurate flight performance information is necessary for consumers to make informed decisions when purchasing airline tickets.

Additional information and analysis are also needed to fully understand the effects of the tarmac delay rule on passengers. Since the rule went into effect, tarmac delays of more than 3 hours have been nearly eliminated, with no delays of more than 4 hours, reducing the hardship for numerous passengers. However, as our analysis has shown, the rule appears to be associated with an increased number of cancellations for thousands of additional passengers—far more than DOT initially predicted—including some who might not have experienced a tarmac delay. Though it is difficult to know how passengers might choose between a long tarmac delay and a cancellation, and what costs and burdens their choices would entail, determining the net benefit to airline passengers resulting from the rule and assessing whether there is a causal relationship between the rule and any changes in flight cancellations will be critical to passengers and airlines. Additionally, our analysis could only include data from the first summer of the rule's implementation, so using data through the summer of 2011 may yield useful information for policymakers. In determining the impact of the rule, it is important to include both the positive effects of reducing long on-board delays and the negative effects of flight cancellations on passengers. Increases in cancellations may be at least partly due to airlines' assumptions about the significant enforcement penalties that could result from a violation of the rule. Although DOT could issue guidance on their penalty structure, it has chosen not to in order to maintain flexibility under their current authority.

Recommendations for Executive Action

To enhance aviation consumers' decision-making, we recommend that the Secretary of Transportation take the following action:

- Collect and publicize more comprehensive on-time performance data to ensure that information on most flights, to airports of all sizes, is included in the Bureau of Transportation Statistics' database. DOT could accomplish this by, for example, requiring airlines with a smaller percentage of the total domestic scheduled passenger service revenue, or airlines that operate flights for other airlines, to report flight performance information.

To enhance DOT's understanding of the impact of tarmac delays and flight cancellations, we recommend that the Secretary of Transportation take the following action:

- Fully assess the impact of the tarmac delay rule, including the relationship between the rule and any increase in cancellations and how they effect passengers and, if warranted, refine the rule's requirements and implementation to maximize passenger welfare and system efficiency.

Agency Comments and Our Evaluation

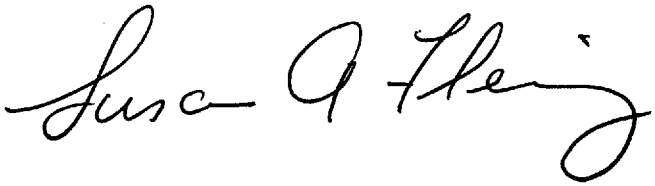
We provided a copy of the draft report to DOT for review and comment. Senior officials at DOT, including the DOT assistant general counsel for aviation enforcement proceedings, provided general comments in an e-mail representing DOT's views on the benefits of the tarmac delay rule, but did not provide written comments on the recommendations. In its general comments, DOT stated that, in its view, available data demonstrate that the tarmac delay rule provided effective consumer protection for airline passengers. DOT officials believe that the rule made clear to airlines that, whatever the rationale, it is not acceptable to leave passengers in aircraft stranded on the ground for hours on end. Specifically, DOT officials cited data that demonstrate the rule's effectiveness in preventing extended tarmac delays, including the elimination of tarmac delays in excess of 4 hours, which dropped from 105 flights to zero for the year ending April 2011, completely eliminating these most egregious of delays. Officials also highlighted the 98 percent drop in 3-hour delays, from 693 flights to 20, during the same period. DOT officials believe that these results demonstrate the positive impact of the tarmac rule, and that without it, far more passengers would have been subject to these extended delays. In response to DOT's general comments, we made changes to the report to better clarify our findings.

DOT officials said that the information in our report, in their view, further demonstrates that airlines have gotten the basic message of the rule and that it has been effective at putting consumers first when it comes to avoiding lengthy tarmac delays. They cited our discussion of actions airlines are taking to avoid tarmac rule violations, including acting more quickly to address delayed flights and moving more quickly back to gates, affording passengers the freedom to access the amenities of air terminals. They were also pleased to see our finding that air carriers are working to comply with DOT requirements to provide food and water to passengers delayed on the tarmac for extended periods of time.

Finally, DOT reinforced its commitment to monitor the effects of the tarmac delay rule to ensure it is achieving intended outcomes and to address any significant unintended outcomes. DOT initially focused on comparing the number of flights with 2-hour tarmac delays that are eventually canceled because in its view this was the best measure of the effect on cancellations from the rule. According to DOT, they recently selected a contractor to conduct a comprehensive independent review and analysis of the impact of the tarmac delay rule now that a full year of data is available. DOT believes that, at minimum, one year of data is necessary to assess the rule's effects. DOT's review will consider on-time performance, cancellations, benefits to consumers, and other relevant information covering the period back to 2000, to assess the rule's impact on flight delays, cancellations, and consumers. DOT also provided technical comments, which were incorporated as appropriate.

As agreed with your offices, unless you publicly announce the contents of this report earlier, we plan no further distribution until 7 days from the report date. At that time, we will send copies to interested congressional committees and the Secretary of Transportation. In addition, this report will be available at no charge on GAO's Web site at http://www.gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-2834 or flemings@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix VI.



Susan Fleming
Director, Physical Infrastructure

Appendix I: Objectives, Scope, and Methodology

In this report, we examined how (1) trends in and reasons for flight delays and cancellations in the United States differ for smaller and larger communities; (2) the Department of Transportation's (DOT) tarmac delay rule has affected passengers and airlines; and (3) requirements and practices for protecting passengers from flight delays, cancellations, and denied boardings in the United States, Canada, and the European Union (EU) have affected passengers and airlines.

To identify and compare the trends in and reasons for flight delays and cancellations in different-sized U.S. communities, we examined trends at airports designated as primary in fiscal year 2009.[1] From this group of 367 airports, we excluded the 12 primary airports in U.S. terrorities because they operate in different operational environments than other U.S. airports. We then categorized the 355 airports by the size of their surrounding community. We used geographic information system data on the airports' location and surrounding population. Airports were mapped by the county they are located in and grouped into one of four categories based on population: 1,000,000 or greater (large metropolitan), 250,000 to 999,999 (midsized metropolitan), 50,000 to 249,999 (small metropolitan), and less than 50,000 (rural). This approach controls for the fact that some small or medium airports—generally secondary airports such as Hobby Airport in Houston—are actually in large metropolitan regions. Using these categories, 78 airports were in large metropolitan communities, 100 were in midsized metropolitan communities, 122 were in small metropolitan communities, and 55 were in rural communities.

To analyze flight delay, cancellation, and diversion trends for these different airport community size categories, we first obtained data from DOT. These data were drawn from the Airline Service Quality Performance System (ASQP), which includes information about flight delays, cancellations, and diversions. ASQP data are based on information filed by airlines each month with DOT's Bureau of Transportation Statistics (Office of Airline Information).[2] Airlines with 1 percent or more of total domestic scheduled passenger service revenue are required to report data for their flights involving any airport in the 48

[1]We excluded commercial service, nonprimary airports because they handle fewer than 10,000 enplanements annually and therefore are not considered "hub" airports that provide connectivity to the national airspace system.

[2]14 C.F.R. part 234.

contiguous states that account for one percent or more of domestic scheduled service passenger enplanements.[3] We then compared the percentage of flights that were delayed, canceled, and diverted by community size, by year.

Since DOT does not require all airlines to report on-time performance information, we also purchased data from FlightStats, a private data source from Conducive Technology that records flight performance information for nearly all airlines and airports. We then conducted the same analysis of delay, cancellation, and diversion trends by airport community size as we did with ASQP data. We also verified DOT and FlightStats data as comparable for similar categories of flights.

ASQP and FlightStats did not have data for all 355 primary airports subject to our examination, because some airports may not have been considered primary in other years of our analysis (very small airports may drop below or rise above the 10,000 enplanements threshold year to year). Furthermore, some airports may have more than 10,000 enplanements annually but generally not be commercial-service airports. For instance, some military airports may have commercial flights diverted to them on occasion. As a result, our analysis of the year 2010, for example, included data for 281 airports using ASQP data and for 344 airports using FlightStats data. Using our community size categories, 76 airports were in large metropolitan communities, 99 were in midsized metropolitan communities, 117 were in small metropolitan communities, and 52 were in rural communities when using FlightStats data.

We also examined trends in sources of delay and cancellation, based on DOT's ASQP data as previously described, and compared these trends by airport community size. FlightStats does not record the sources or reasons for delays or cancellations.

[3]The regulation also provides for the voluntary reporting of an airline's entire domestic system and voluntary reporting by other airlines. For calendar year 2010, the reporting airlines were AirTran Airways, Alaska Airlines, American Airlines, American Eagle Airlines, Atlantic Southeast Airlines, Comair, Continental Airlines, Delta Air Lines, ExpressJet Airlines, Frontier Airlines, Hawaiian Airlines, JetBlue Airways, Mesa Airlines, Northwest Airlines, Pinnacle Airlines, SkyWest Airlines, Southwest Airlines, United Airlines, and US Airways. Other airlines reported data in other years of our analysis when they accounted for at least one percent of total domestic scheduled passenger service revenue.

To assess the reliability of ASQP and FlightStats data, we reviewed documentation related to both data sources, and interviewed knowledgeable officials at DOT and Conducive Technology about the data. We also compared data for the same categories of flights in both DOT and FlightStats databases, where possible, and found that they were similar. After excluding certain ASQP flight records for our analysis of tarmac delay trends, we determined that both ASQP and FlightStats data were sufficiently reliable for the purposes of this report.[4]

To better understand the reasons for any differing trends in and sources of flight delays and cancellations, we reviewed a DOT Office of Inspector General report and interviewed aviation industry experts, consumer groups, industry associations, and representatives of three U.S. legacy airlines and three low-cost airlines. For the U.S. airlines, we selected three legacy airlines that served more than two-thirds of all legacy airline passengers from 2004 through June 2010 and three low-cost airlines that served more than 80 percent of all low-cost airline passengers from 2004 through June 2010. These six airlines served about half of all passengers enplaned on U.S. airlines from 2004 through June 2010. See table 5 for a list of aviation industry stakeholders, including airlines, interviewed for this report.

[4]Beginning in October 2008, DOT required airlines to submit tarmac delay statistics to ASQP for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we omitted these flights from our analysis of tarmac delay trends from 2004 to 2010. Our analysis of tarmac delay trends also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns. Specifically, some airlines misreported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis of tarmac delay trends did not include data for international flights.

Table 5: U.S. Stakeholders Interviewed

Government agencies
Department of Transportation • Federal Aviation Administration • Bureau of Transportation Statistics • Office of the Assistant General Counsel for Aviation Enforcement & Proceedings • Office of the Assistant General Counsel for International Law
Academics and consultants
Peter Belobaba, Massachusetts Institute of Technology
Amy Cohn, University of Michigan
Mark Hansen, University of California, Berkeley
Darryl Jenkins, ACG Aviation Consulting Group, LLC
Joshua Marks, Marks Aviation, LLC
Lance Sherry, George Mason University
Consumer groups
American Society of Travel Agents
Association for Airline Passenger Rights
Business Travel Coalition
Consumer Travel Alliance
Consumers Union
FlyersRights
Industry associations
Air Carrier Association of America
Air Transport Association
International Air Transport Association
Regional Airline Association
U.S. legacy airlines
American Airlines
Delta Air Lines
United Airlines
U.S. low-cost airlines
JetBlue Airlines
Southwest Airlines
Spirit Airlines

Source: GAO.

To assess how DOT's tarmac delay rule has affected passengers and airlines, we first examined DOT data on tarmac delay and cancellation trends since 2004. In order to identify the frequency of tarmac delays over time, we used DOT's ASQP data to identify all flights with tarmac delays greater than 3 hours from January 2004 through September 2010.[5] We then analyzed these flights by year; month; time of day; and type of tarmac delay, such as taxi-in and taxi-out delays (see app. III for more information on these trends since 2004).

To better understand the effect of the tarmac delay rule on the likelihood of flight cancellations, we assessed cancellations in two contexts. In the first, we assessed the odds of a flight being canceled after it leaves the gate. In the second, we assessed the odds of a flight being canceled before it leaves the gate. In order to isolate the effect of the tarmac delay rule, we analyzed flight data using models that controlled for a variety of factors that can affect an airline's decision to cancel a flight. Specifically, we used logistic regression models to estimate the impact of the tarmac delay rule on cancellations. Using these models, we were able to control for other factors that may affect the likelihood of a cancellation, including weather at the origin and destination airport, airport and airline characteristics, and specific details of individual flights. Disruptive weather is a major cause of cancellations, so by including variables in our model for severe weather events, we were better able to isolate the rule's correlation with cancellations. Further, the size of the particular airport, as well as the size and business practices of airlines, influence cancellation decisions, so we controlled for certain characteristics of airports and airlines. (See app. V for more details on our models.) To verify the strength of our model, we discussed the models' design and preliminary results with aviation experts Professor Mark Hansen of the University of California and Professor Lance Sherry of George Mason University. We also spoke with representatives of U.S. airlines, industry associations, consumer groups, and DOT about the impact of the tarmac delay rule, including changes to airline practices.

Finally, to determine how the requirements and practices for protecting passengers from flight delays, cancellations, and denied boardings in the

[5]Additionally, our analysis excluded flights reported to DOT by Atlantic Southeast Airlines, Comair, and Hawaiian Airlines due to errors in how they reported the data to DOT. Our analysis also eliminated flights delayed more than 10 hours because there were errors in the reporting as confirmed by DOT.

United States, Canada, and the EU have affected passengers and airlines, we examined the laws, regulations, international agreements, and voluntary commitments governing passenger protections in the three regions. In particular, we reviewed applicable DOT regulations, Regulation (EC) 261/2004, and relevant provisions of Canada's Air Transportation Regulations and the Montreal Convention. Additionally, we examined government guidance and proposals for additional passenger protections, including the Flight Rights Canada Initiative, European Commission guidance for enforcement bodies, and Canada's proposed Air Passenger's Bill of Rights. To describe voluntary passenger protections offered by airlines, we reviewed the contracts of carriage for nine largest U.S. airlines based on recent Federal Aviation Administration (FAA) data on the number of available seat miles. We also spoke with airline officials from three airlines in Canada and officials from three European airlines. To further examine the affect that passenger protection regulations have had on airlines and passengers, we interviewed airline, industry association, consumer group, and government officials throughout all three regions. We also assessed DOT data on denied boardings from 2004 through 2010.[6] To document how regions enforce passenger protection requirements differently, we visited and spoke with stakeholders in Canada and in the EU, which were selected based on stakeholder comments and a review of a recent EC study on the implementation of the EU regulation. In the EU, we selected The Netherlands and Germany because each has a large aviation market as well as active and effective enforcement practices, but which employ different strategies. See tables 6 and 7 for a list of stakeholders we met with in Canada and the EU.

[6]Similar data was not publicly available in Canada or the EU.

Table 6: Canadian Stakeholders Interviewed

Airlines
Air Canada
Air Transat
WestJet
Consumer groups
Consumer Association of Canada
Government agencies
Canadian Transportation Agency
NavCanada
Transport Canada
Industry association
Canadian Airports Council

Source: GAO.

Table 7: European Stakeholders Interviewed

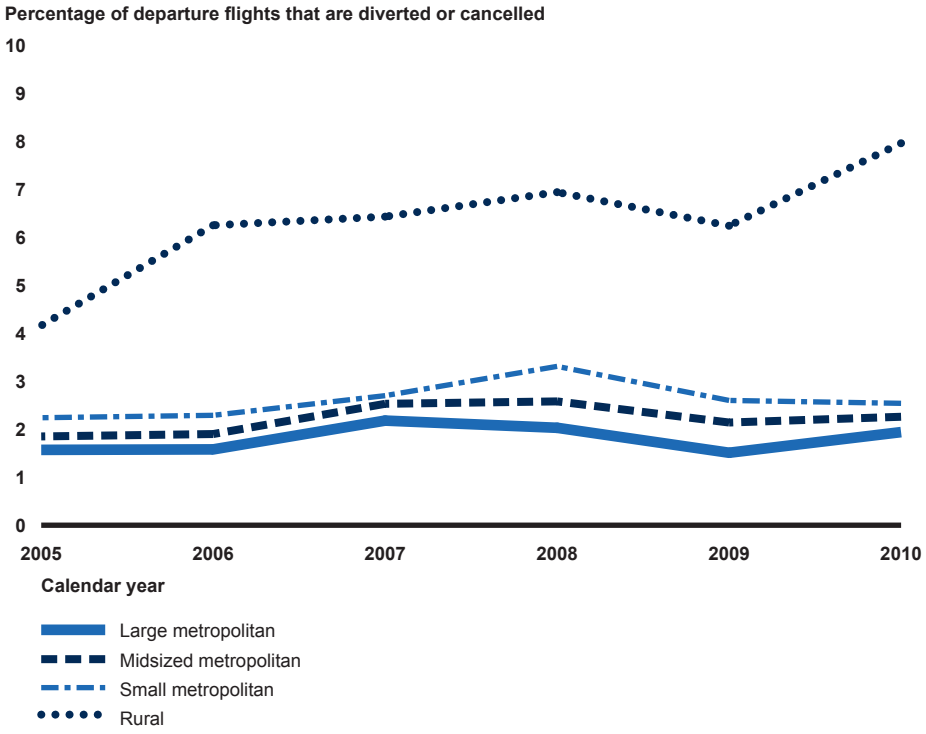
Airlines
EasyJet
KLM
Lufthansa
Consumer groups
Consumentenbond (Netherlands)
Federation of German Consumer Organisations
Government agencies
EC, Directorate-General for Mobility and Transport
Germany, Federal Ministry of Food, Agriculture and Consumer Protection
Germany, Federal Ministry of Transport, Building and Urban Affairs
Germany, Luftfahrt-Bundesamt
The Netherlands, Ministry of Transport, Inspectorate for Transport, Public Works and Water Management
United Kingdom, Civil Aviation Authority
Industry associations
Association of European Airlines
European Low Fares Airline Association
European Regions Airline Association
German Airline Federation

Source: GAO.

Appendix II: Delay, Cancellation, and Diversion Trends

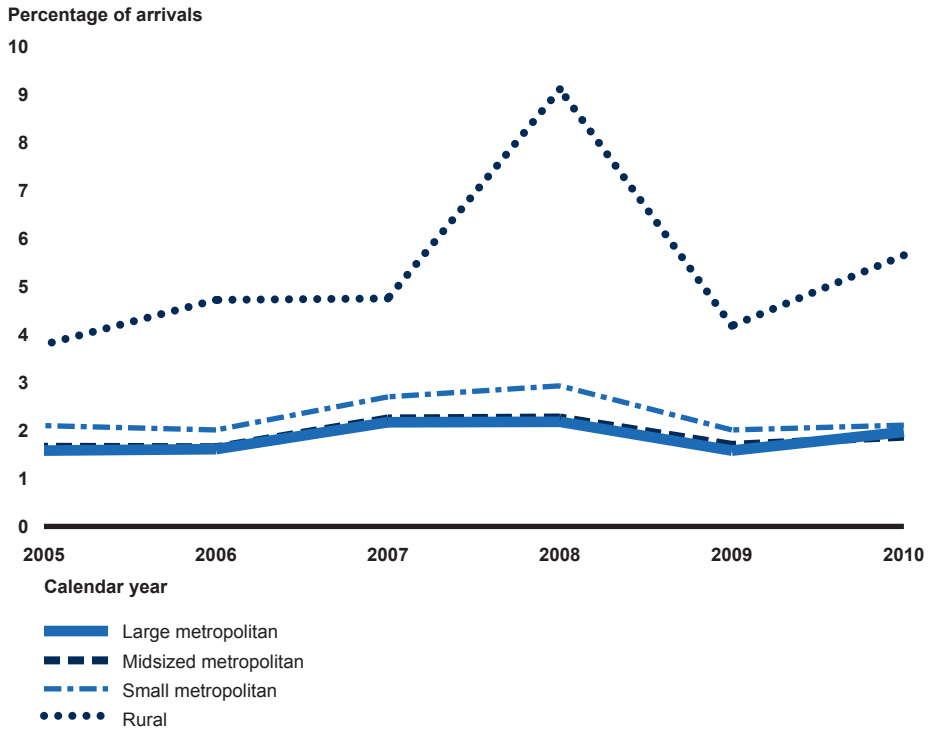
This appendix provides additional information and illustrations of flight delay, cancellation, and diversion trends from 2005 to 2010, based on our analysis of FlightStats data. It also provides information on airline-reported sources of delays and cancellations, based on our analysis of DOT data.

Figure 12: Percentage of Departure Flights Canceled and Diverted by Community Size, Calendar Years 2005–2010



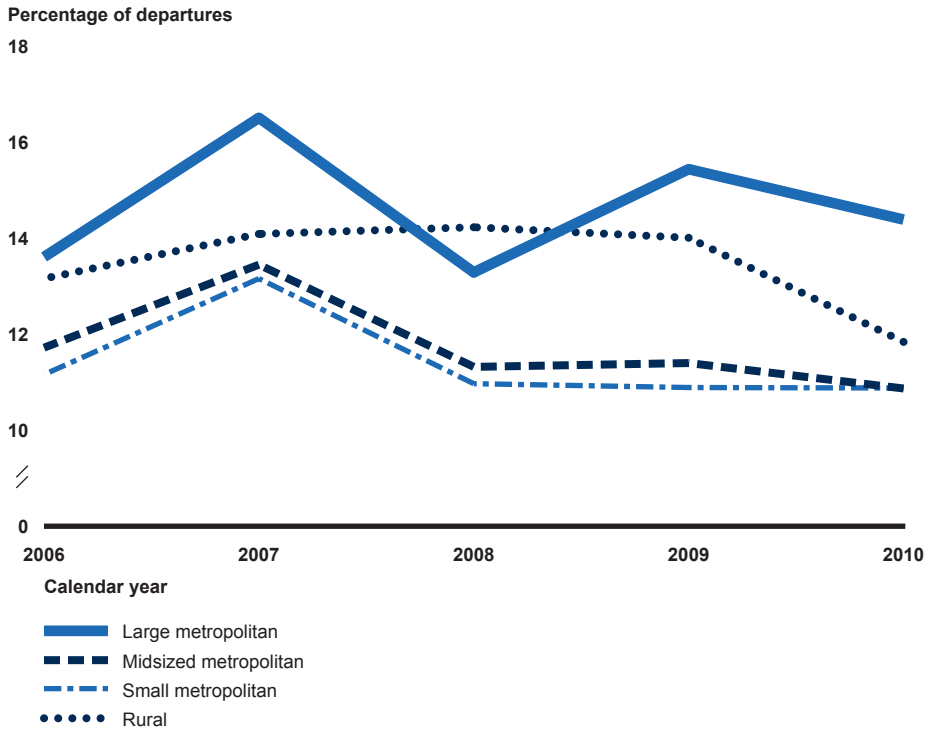
Source: GAO analysis of FlightStats data.

Figure 13: Percentage of Arrival Flights Canceled and Diverted by Community Size, Calendar Years 2005–2010



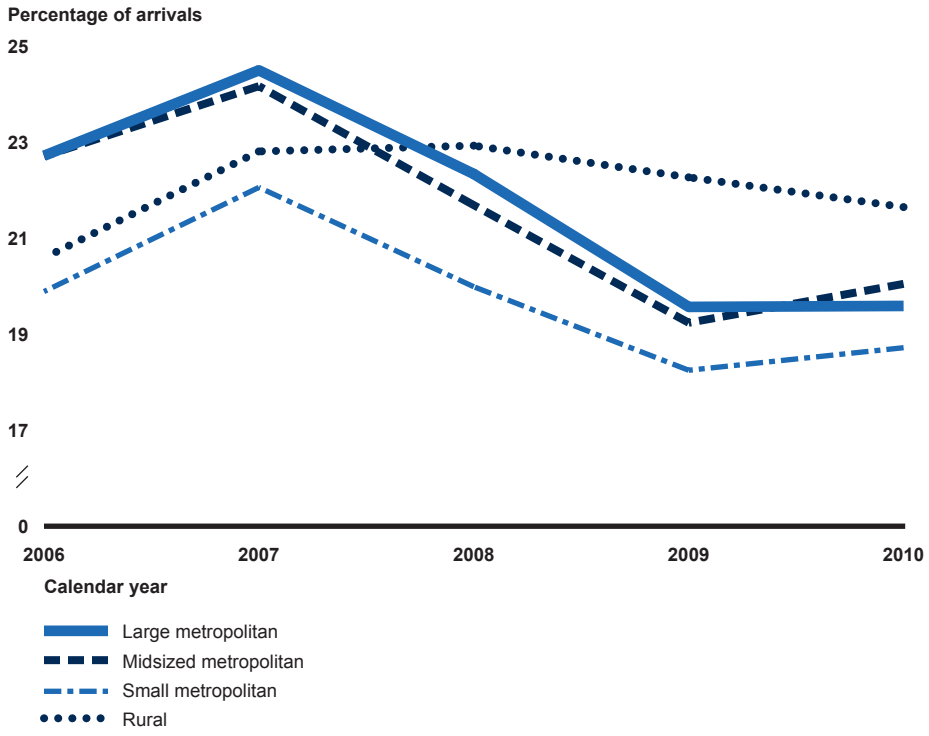
Source: GAO analysis of FlightStats data.

Figure 14: Percentage of Delayed Departure Flights by Community Size, Calendar Years 2006–2010



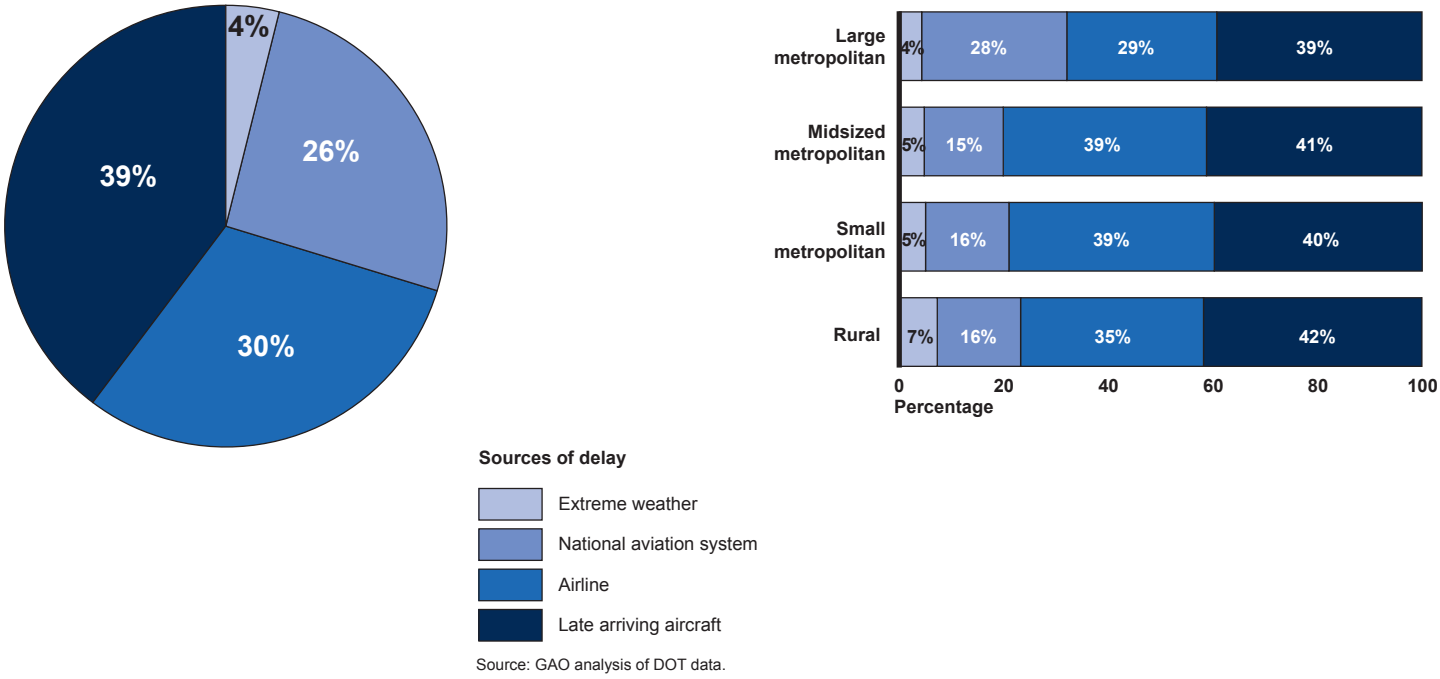
Source: GAO analysis of FlightStats data.

Figure 15: Percentage of Delayed Arrival Flights by Community Size, Calendar Years 2006–2010



Source: GAO analysis of FlightStats data.

Figure 16: Airline-Reported Sources of Delay in Calendar Year 2010



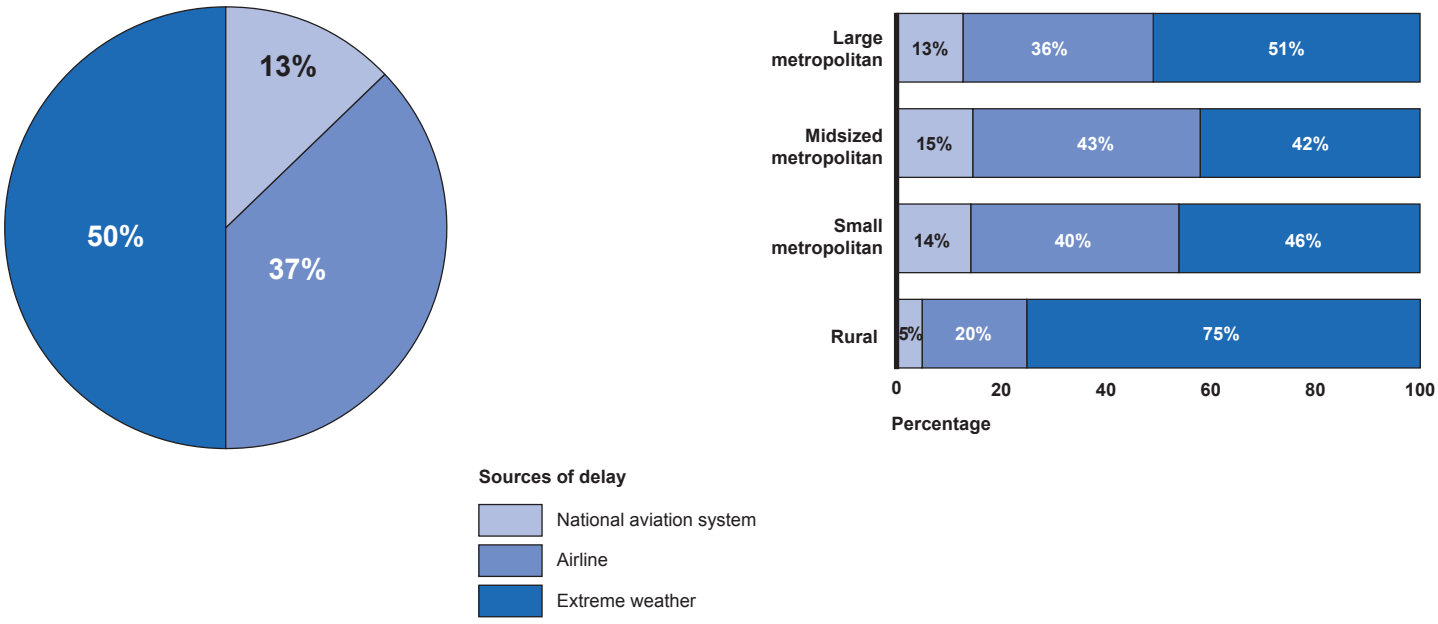
Source: GAO analysis of DOT data.

Notes:

1. Numbers may not add to 100 due to rounding.

2. Security delays do not appear this graphic because they make up less than 0.5 percent of the delays.

Figure 17: Airline-Reported Sources of Cancellations in Calendar Year 2010



Source: GAO analysis of DOT data.

Notes:

1. Numbers may not add to 100 due to rounding.

2. Security delays do not appear on this graphic because they make up less than 0.5 percent of cancellations.

Appendix III: Tarmac Delay Trends Since 2004

This appendix provides additional information and illustration of tarmac delays of more than 3 hours, from January 2004 through September 2010, including how the tarmac delays that occurred during this period were distributed by year, month, airport, day of the week, and hour. This appendix also provides information on airline-reported sources of tarmac delays. This information is based on our analysis of DOT data.

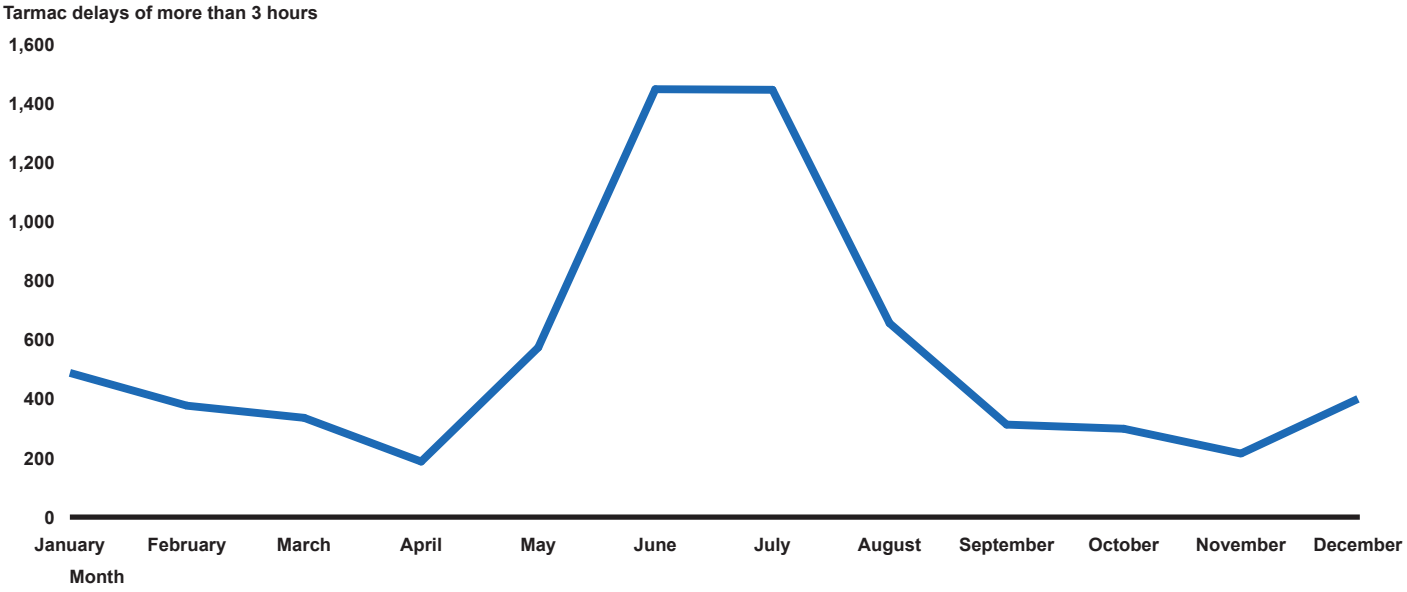
Table 8: Total Number of Tarmac Delays of More than 3 Hours by Stage of Operation, January 2004–September 2010

Total by year	Taxi-out tarmac delays	Taxi-in tarmac delays
2004	1,169	70
2005	983	32
2006	1,220	58
2007	1,507	30
2008	1,056	17
2009	520	2
2010	72	4
Total	**6,527**	**213**

Source: GAO analysis of DOT data.

Note: Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns, prior to October 2008. Specifically, some airlines mis-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

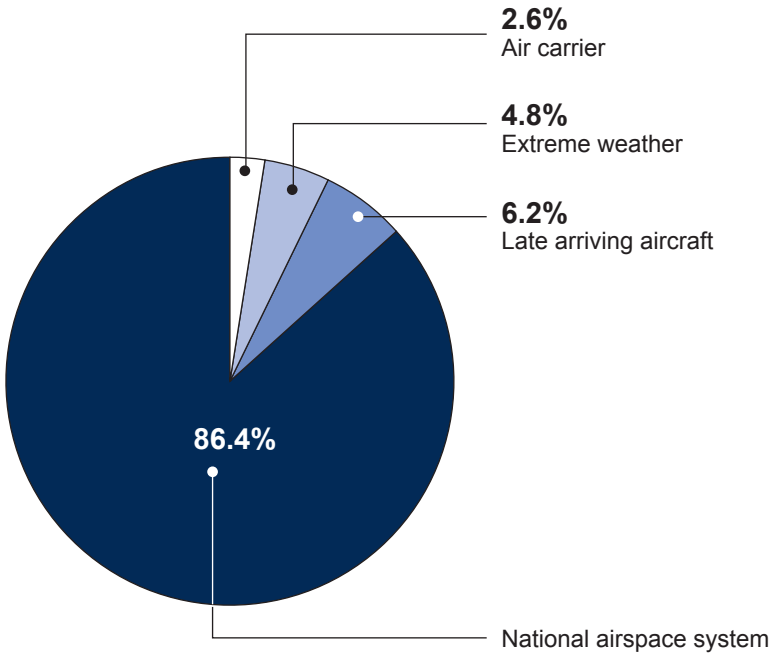
Figure 18: Total Number of Tarmac Delays of More than 3 Hours by Month, January 2004–September 2010



Source: GAO analysis of DOT data.

Note: Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns, prior to October 2008. Specifically, some airlines mis-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Figure 19: Airline-Reported Sources of Delay for all Tarmac Delays of More than 3 Hours, January 2004–September 2010



Source: GAO analysis of DOT data.

Notes:

1. Numbers may not add up to 100 due to rounding.

2. Security delays do not appear on this graphic because they make up less than 1 percent of delays at these airports. DOT collects cancellation causal data in one of four categories: (1) national aviation system (a broad set of circumstances affecting airline flights, such as nonextreme weather that slows down the system, but does not prevent flying), (2) airline (any delay that was within the control of the airlines, such as aircraft cleaning, baggage loading, crew issues, or maintenance), (3) extreme weather (serious weather conditions that prevent the operation of a flight, such as tornadoes, snowstorms, or hurricanes), and (4) security (such as, evacuation of an airport, reboarding because of a security breach, and long lines at the passenger screening areas). According to DOT, airlines cannot report “late arriving aircraft” as a reason for a canceled flight (though they can assign that cause to delayed flights) since ultimately this reason would fall under the airline category because airlines can have a spare aircraft available when flights arrive late. Therefore, “late arriving aircraft” is an airline related cause for a cancellation that an airline could have prevented. Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures, prior to October 2008. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns. Specifically, some airlines mis-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Table 9: Total Number of Tarmac Delays of More than 3 Hours at 35 Airports and Systemwide, January 2004–September 2010

Airport	Taxi-out tarmac delays	Taxi-in tarmac delays
Atlanta Hartsfield International	240	3
Baltimore-Washington International	65	6
Boston Logan International	140	7
Charlotte/Douglas International	123	2
Chicago Midway	39	0
Chicago O'Hare International	736	3
Cincinnati-Northern Kentucky	75	3
Cleveland-Hopkins International	29	1
Dallas-Fort Worth International	436	11
Denver International	75	2
Detroit Metro Wayne County	51	2
Fort Lauderdale-Hollywood International	25	3
George Bush Intercontinental	284	5
Greater Pittsburgh International	28	1
Lambert St. Louis International	17	0
Las Vegas McCarran International	10	8
Los Angeles International	15	17
Memphis International	26	2
Miami International	57	3
Minneapolis-St Paul International	55	2
New York John F. Kennedy International	888	0
New York LaGuardia	495	6
Newark International	865	1
Orlando International	27	6
Philadelphia International	588	2
Phoenix Sky Harbor International	16	2
Portland International	1	2
Ronald Reagan National	143	4
Salt Lake City International	34	1
San Diego International Lindbergh	0	6
San Francisco International	6	5
Seattle -Tacoma International	4	4
Tampa International	16	5
Washington Dulles International	208	4
Systemwide	6,527	213

Source: GAO analysis of DOT data.

Note: According to FAA, the 35 Operational Evolution Partnership airports listed above are commercial airports with significant activity and were selected in 2000 on the basis of lists from FAA and Congress as well as a study that identified the most congested airports in the United States. Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns. Specifically, some airlines miss-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Table 10: Total Number of Tarmac Delays of More than 3 Hours by Day of the Week, January 2004–September 2010

Day of the week	Number of tarmac delays
Monday	714
Tuesday	1,145
Wednesday	1,395
Thursday	1,375
Friday	914
Saturday	431
Sunday	766
Total	**6,740**

Source: GAO analysis of DOT data.

Note: Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns, prior to October 2008. Specifically, some airlines mis-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Table 11: Total Number of Tarmac Delays of More than 3 Hours by Hour, January 2004–September 2010

Departure hour	Taxi-out tarmac delays	Taxi-in tarmac delays	Total
12:00 a.m.	1	0	**1**
5:00 a.m.	23	0	**23**
6:00 a.m.	135	5	**140**
7:00 a.m.	229	13	**242**
8:00 a.m.	215	10	**225**
9:00 a.m.	192	4	**196**
10:00 a.m.	152	5	**157**
11:00 a.m.	193	14	**207**
12:00 p.m.	269	18	**287**
1:00 p.m.	526	13	**539**
2:00 p.m.	557	20	**577**
3:00 p.m.	747	21	**768**
4:00 p.m.	716	21	**737**
5:00 p.m.	894	27	**921**
6:00 p.m.	717	19	**736**
7:00 p.m.	507	9	**516**
8:00 p.m.	331	9	**340**
9:00 p.m.	94	3	**97**
10:00 p.m.	25	1	**26**
11:00 p.m.	4	1	**5**
Total	**6,527**	**213**	**6,740**

Source: GAO analysis of DOT data.

Note: Beginning in October 2008, DOT required airlines to submit tarmac delay statistics for three additional categories: flights that are subsequently canceled or diverted or have multiple gate departures. For consistency, we have omitted these flights from this figure. Our analysis also excluded flights reported to DOT by Atlantic Southeast Airlines, Hawaiian Airlines, and Comair because, according to DOT, these airlines inconsistently reported gate returns, prior to October 2008. Specifically, some airlines mis-reported the gate-departure or takeoff time resulting in an incorrect tarmac delay calculation. Further, our analysis excluded data for any flights with tarmac delays of more than 10 hours since there were errors in the reporting of many such flights. Finally, our analysis did not include data for international flights. As a result of these exclusions for data reliability purposes, this figure likely under-reports tarmac delays of more than 3 hours for these years. See appendix IV for more information on recent tarmac delays.

Appendix IV: Tarmac Delay Trends since October 2008

Beginning in October 2008, DOT required airlines to submit data on flights with tarmac delays that were subsequently canceled, diverted, or had multiple gate departures (see table 12). Previously, DOT had only captured tarmac delays that occurred during taxi-out or during taxi-in. While the majority of tarmac delays happen at taxi-out or taxi-in, the change in reporting captured data for some additional tarmac delays of more than 3 hours. As a result of these new reporting requirements, tarmac delays are now captured

- during taxi-out: the time between when a flight departs the gate at the origin airport and when it lifts off from that airport (wheels-off);
- during taxi-in: the time between a flight touching down at its destination airport (wheels-on) and arriving at the gate;
- prior to cancellation: flight left the gate but was canceled at the origin airport;
- during a diversion: the tarmac time experienced at an airport other than the destination airport; or
- as a result of a multiple gate departure: the flight left the gate, then returned, and then left again; the tarmac time is the time before the return to the gate.

Table 12: Tarmac Delays of More than 3 Hours, October 2008–December 2010

	Tarmac times		Stage of operation					
Month	Total	Percentage of regularly scheduled flights	Prior To cancellation	Multiple gate departure	Taxi-out	Taxi-in	At diversion airport	Number of regularly scheduled flights
October 2008	**46**	0.01%	2	5	33	0	6	556,205
November 2008	**7**	0	0	1	4	0	2	523,272
December 2008	**183**	0.03	40	13	113	7	10	544,956
January[a] 2009	**85**	0.02	7	10	68	0	0	532,339
February 2009	**40**	0.01	5	3	32	0	0	488,410
March 2009	**85**	0.02	6	9	63	0	7	557,422
April 2009	**74**	0.01	10	8	45	0	11	537,793
May 2009	**34**	0.01	7	2	24	1	0	546,832
June 2009	**268**	0.05	38	40	167	1	22	557,594
July 2009	**161**	0.03	21	20	102	0	18	580,134
August 2009	**66**	0.01	6	10	43	0	7	568,301
September 2009	**6**	0	0	0	4	0	2	510,852
October 2009	**11**	0	0	0	11	0	0	531,799
November 2009	**4**	0	0	1	2	0	1	509,540
December 2009	**34**	0.01	4	3	22	0	5	529,269
January 2010	**20**	0	1	3	11	2	3	521,809
February 2010	**60**	0.01	5	1	52	1	1	483,270
March 2010	**25**	0	9	2	11	1	2	549,262
April 2010	**4**	0	0	0	1	0	3	529,330
May 2010	**1**	0	0	0	1	0	0	542,747
June 2010	**3**	0	2	0	1	0	0	551,687
July 2010	**3**	0	3	0	0	0	0	570,788
August 2010	**1**	0	0	0	0	0	1	569,217
September 2010	**4**	0	2	2	0	0	0	526,107
October 2010	**0**	0	0	0	0	0	0	545,519
November 2010	**0**	0	0	0	0	0	0	520,999
December 2010	**3**	0	1	1	0	0	1	539,382

Source: DOT.

[a]According to DOT, January 2009 includes one flight with two separate 3-hour tarmac times. Northwest Flight 1491, on January 28, 2009, was on the tarmac for 188 minutes before returning to the gate. The flight departed the gate a second time and was on the tarmac for 199 minutes before wheels-off. Details of the flight are listed as a 3-hour multiple gate departure delay and a 3-hour taxi-out delay.

Table 13: Tarmac Delays of More than 3 Hours, May 2010–April 2011

Date	Stage of flight	Airline	Origin	Destination	Delay or cancellation cause	Minutes over 3 hours	DOT outcome
5/28/10	During taxi-out	Delta Air Lines	ATL	DFW	National aviation system	2	No violation
6/18/10	Prior to cancellation	United Airlines	ORD	LGA	Extreme weather	5	Violation; airline warned
6/18/10	Prior to cancellation	United Airlines	ORD	ATL	Extreme weather	3	Violation; airline warned
6/18/10	During taxi-out	United Airlines	ORD	IAD	National aviation system	2	Violation; airline warned
7/23/10	Prior to cancellation	American Eagle	ORD	BNA	Extreme weather	34	No violation
7/23/10	Prior to cancellation	American Eagle	ORD	RDU	Extreme weather	19	No violation
7/23/10	Prior to cancellation	American Eagle	ORD	BWI	Extreme weather	18	No violation
8/5/10	At diversion airport	United Airlines	SJU	IAD	n/a	20	No violation
9/22/10	Prior to cancellation	US Airways	JFK	CLT	Air carrier	17	No violation
9/22/10	Prior to cancellation	Delta Air Lines	PHL	DTW	Extreme weather	3	No violation
9/22/10	During multiple gate departure	Southwest	PHL	STL	Extreme weather and national aviation system	19	Violation; airline warned
9/22/10	During multiple gate departure	Pinnacle	JFK	ORD	Extreme weather and national aviation system	5	No violation
12/12/10	During multiple gate departure	Delta Air Lines	DTW	MIA	Extreme weather and national aviation system	12	No violation
12/12/10	Prior to cancellation	Pinnacle	DTW	CID	Extreme weather	6	No violation
12/27/10	At diversion airport	United Airlines	SAN	SFO	n/a	9	No violation
1/10/11	Prior to cancellation	Delta Air Lines	ATL	HNL	Extreme weather	31	Under investigation
4/24/11	Prior to cancellation	United Airlines	JFK	SFO	Extreme weather	22	Under investigation
4/27/11	Prior to cancellation	Delta Air Lines	ATL	SLC	Air carrier	22	Under investigation
4/27/11	Prior to cancellation	Delta Air Lines	ATL	ONT	Air carrier	20	Under investigation

Date	Stage of flight	Airline	Origin	Destination	Delay or cancellation cause	Minutes over 3 hours	DOT outcome
4/27/11	During taxi-out	Delta Air LInes	ATL	FLL	National aviation system and air carrier	5	Under investigation

Source: GAO analysis of DOT data.

Note: ATL (Atlanta Hartsfield International), BNA (Nashville International Airport), BWI (Baltimore-Washington International), CID (Cedar Rapids Iowa), CLT (Charlotte/Douglas International), DFW (Dallas-Fort Worth International), DTW (Detroit Metro Wayne County), FLL (Fort Lauderdale Hollywood International), HNL (Honolulu International), IAD (Washington Dulles International), JFK (New York John F. Kennedy International), LGA (LaGuardia International), MIA (Miami International), ONT (Ontario International), ORD (Chicago O'Hare International), PHL (Philadelphia International), RDU (Raleigh- Durham International Airport), SAN (San Diego International Lindbergh), SFO (San Francisco International), SJU (Luis Munoz Marin International Airport), SLC (Salt Lake City International), and STL (Lambert St. Louis International).

Appendix V: Tarmac Delay Logistic Regression Analysis

This appendix describes two models that we designed to assess whether DOT's tarmac delay rule is correlated with an increase in airline cancellations. Both models use data for the same months before and after the rule went into effect to analyze whether and how a variety of factors—including the imposition of the rule—are associated with the likelihood (or odds) that a flight will be canceled. One model analyzes the likelihood of cancellation after a flight has left the gate and gone onto the tarmac; the other analyzes the likelihood of cancellation at the gate. Specifically, this appendix discusses (1) the incidence of cancellations since the rule's implementation, (2) the conceptual framework for examining these issues through modeling, (3) variable calculations and data sources, and (4) the models' results.

Incidence of Flight Cancellations in 2010 Relative to 2009

To examine the incidence of flight cancellations before and after the tarmac rule's implementation, we collected data on flights for May through September in 2009—before the rule went into effect—and for the same months in 2010, after the rule's implementation.[1] We examined the incidence of cancellation for flights that were canceled after they left the gate and went onto the tarmac, and for flights before they left the gate. The data cover flights reported to the Bureau of Transportation Statistics (BTS) at 70 airports in the continental United States.[2]

Table 14 provides information, for the time frame of this analysis, on the number of flights in each time period that left the gate and took off, and

[1]While data were available for later months in 2010, which we could have compared with the same months in 2009, we believe that factors affecting cancellations during winter months differ considerably from factors that influence cancellations during summer months, when weather is less predictable ahead of time. Thus, we believe that if the rule has increased cancellations, it would do so primarily during summertime weather events, and, that is therefore, the focus of this model.

[2]Both models analyze flights between 70 airports in the United States and Puerto Rico. The FAA Aviation System Performance Metrics database includes performance data on operations at 77 airports. Our analysis included domestic flights operated by DOT reporting airlines to and from these airports, with the exception of three in Alaska and Hawaii (Ted Stevens Anchorage International Airport, Honolulu International Airport, and Kahului Airport) which we chose not to include, and four airports (Gary Chicago International Airport, Greater Rockford Airport, Teterboro Airport, and Van Nuys Airport) that had no reported flights to or from any of the other ASPM airports during the months of our analysis. In addition, for the tarmac model (but not for the gate model) we did not include flights that were diverted and thus did not land at the scheduled destination airport and flights that had longer than a 60 minute taxi-in delay at the destination airport.

the number of flights that left the gate but eventually were canceled. From that information we calculate the odds of cancellation in each of the two years. These odds equal the number of flights that were canceled divided by the number of flights that were not canceled. For example, in 2009, the odds of cancellation is (808/1,868,189), which equals 0.000433. Thus, roughly 4 out of every 10,000 flights that exited the gate were ultimately canceled in that year. Finally, we calculated the odds ratio of a flight being canceled in 2010 compared with 2009, which is a ratio of the odds of cancellation in 2010 to the odds of cancellation with 2009.

Table 14: Unadjusted Odds Ratio for Tarmac Cancellation, 2010 versus 2009

Year (May–September)	Number of flights not canceled	Number of flights canceled	Odds of cancellation	Odds ratio, 2010 compared with 2009
2009	1,868,189	808	0.000433	
2010	1,845,296	992	0.000538	1.24

Source: GAO analysis of DOT data.

Notes:

1. "Unadjusted" means that this analysis has not controlled for other factors that may influence the incidence of cancellation.

2. These results are based on analysis of all flights, operated by DOT reporting airlines, to and from 70 of the FAA's Aviation System Performance Metrics 77 airports in the United States and Puerto Rico. These results differ from the cancellation trends presented in table 1 of the report because table 1 illustrated trends by these same airlines across the entire system and not just at these 70 airports.

The data show that flights are rarely canceled after leaving the gate. In both years, a very small fraction of flights that left the gate were ultimately canceled. As noted, in 2009 roughly 4 flights (that left the gate) were canceled for every 10,000 flights that took off. However, the odds of cancellation for a flight that has left the gate did appear to rise in 2010 compared with 2009. The odds ratio is the odds of a tarmac cancellation in 2010 divided by the odds of such a cancellation in 2009. The odds ratio exceeds 1, indicating that cancellations were more likely to occur in 2010. Specifically there was about a 24 percent increase in the odds of cancellation in 2010 compared with a year earlier.

Because we hypothesized that the likelihood of cancellation for a flight that has left the gate may be greater the longer it sits on the tarmac, we assessed the odds of cancellation based on how long a flight sits on the tarmac, as shown in table 15. These data reveal that in both 2009 and 2010, the odds of cancellation rise substantially for flights that have been

on the tarmac for longer periods of time. For example, in 2009 the odds of cancellation for flights on the tarmac 60 minutes or less are only a small fraction of a percent, but for flights on the tarmac for 121 to 180 minutes, the odds rise substantially to 6 percent in that year. Using these odds, we calculate odds ratios showing the relative odds of cancellation for each hour category compared with the base hour (up to 1 hour of delay), within each year. As shown, the odds ratios rise dramatically as more time passes on the tarmac—a 42-fold increase in the odds of cancellation when a plane has been sitting on the tarmac for 61 to 120 minutes compared with a delay of 60 or less minutes in 2009.

Table 15: Unadjusted Odds Ratio for Tarmac Cancellation, 2010 versus 2009, by Time Spent on Tarmac

Year (May–September)	Time on tarmac (minutes)	Number of flights not canceled	Number of flights canceled	Odds of cancellation	Odds ratio, time on tarmac compared with 0 to 60 minute time, within a given year	Odds ratio, time on tarmac in 2010 compared with same time on tarmac 2009
2009	0–60	1,848,276	452	0.000244		
	61–120	17,707	184	0.01039	42	
	121–180	1,912	116	0.06067	248	
2010	0–0	1,830,874	561	0.000306		1.25
	61–120	13,591	266	0.019571	63	1.88
	121–180	829	159	0.191797	626	3.16

Source: GAO analysis of DOT data.

Notes:

1. “Unadjusted” means that this analysis has not controlled for other factors that may influence the incidence of cancellation.

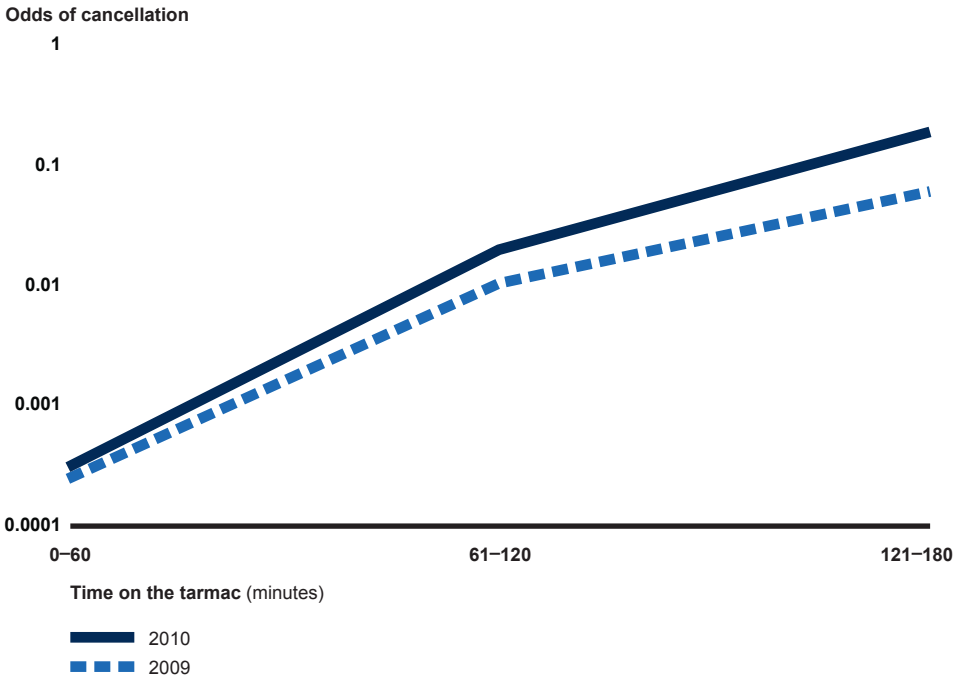
2. These values may not exactly equal the values based on division because the odds ratios presented here are based on unrounded numbers. Data for tarmac delays of more than 3 hours are not included in the table because for 2010 the number of such delays was only eight and we decided that odds ratios based on such small numbers may not be representative.

3. These results are based on analysis of all flights, operated by DOT reporting airlines, to and from 70 of the FAA’s Aviation System Performance Metrics 77 airports in the United States. and Puerto Rico. These results differ from the cancellation trends presented in table 1 of the report because table 1 illustrated trends by these same airlines across the entire system and not just at these 70 airports.

These data provided in table 15 also reveal that for every “time-on-the-tarmac” category, the odds of cancellation in 2010 exceeded the odds of cancellation in 2009 because all of the odds ratios (shown in the far right column) exceed 1. We calculated these odds ratios by taking the odds of cancellation in one tarmac time category in 2010 and dividing it by the odds of cancellation for the same tarmac time category in 2009. These

data further show that the differential between the likelihood for cancellation in 2010 over 2009 rose the longer a flight was on the tarmac. While the odds of cancellation for flights on the tarmac for 60 or less minutes were 25 percent greater in 2010 than in 2009, for flights on the tarmac 121 to 180 minutes, there was a threefold greater odds of cancellation in 2010 compared to 2009. Figure 20 shows how the relative odds of flight cancellation in 2010 compared to 2009 increases the longer a flight sits on the tarmac.

Figure 20: Odds of Cancellation for Flights on the Tarmac, 2010 and 2009



Source: GAO analysis of DOT data.

Finally, we calculated odds ratios to examine the relative odds of flight cancellations at the gate in 2010 and 2009. Table 16 shows the odds of cancellation each year and the odds ratio for gate cancellations in 2010 compared with 2009. The odds of a gate cancellation were 13 percent greater in 2010 compared with 2009.

Table 16: Unadjusted Odds Ratio for Gate Cancellation, 2010 versus 2009

Year (May–September)	Number of flights that taxi away from the gate	Number of flights canceled at the gate	Odds of Gate cancellation	Odds ratio, 2010 compared with 2009
2009	1,868,997	16,850	0.00902	
2010	1,846,288	18,807	0.01019	1.13

Source: GAO analysis of DOT data.

Notes:

1. "Unadjusted" means that this analysis has not controlled for other factors that may influence the incidence of cancellation.

2. These results are based on analysis of all flights, operated by DOT reporting airlines, to and from 70 of the FAA's Aviation System Performance Metrics 77 airports in the United States and Puerto Rico. These results differ from the cancellation trends presented in table 1 of the report because table 1 illustrated trends by these same airlines across the entire system and not just at these 70 airports.

Conceptual Framework of Models

While the unadjusted odds ratios indicate that the likelihood of both tarmac and gate cancellations increased in May through September 2010 relative to the same time period in 2009, this increase may or may not be attributable to the tarmac delay rule in 2010. Many factors may contribute to flight cancellations, and there could be an observed difference across two years for a number of reasons. For example, weather events may disrupt traffic more in one year than in another, or airline scheduling or traffic patterns could change over time. To develop a model to examine this issue, it is helpful to first consider whether there is any reason why the tarmac rule might be correlated with flight cancellations. In particular, what is it about airline behavior that could be influenced by the tarmac delay rule?

Model Hypothesis

When there are flight disruptions, airlines face a trade-off between the consequences of delays they might incur and cancellations. For example, when bad weather reduces airport capacity, thus slowing the rate at which flights can take off or land at an airport, airlines must decide how to ration their traffic. They can choose to hold to their schedule and fly all their flights, but risk long delays. Alternatively, they can choose to cancel some of their flights, thus mitigating the capacity constraint they face and reducing the amount of delays for their remaining flights. Although airlines have some control over these trade-offs, airport capacity—both in gate space and on the tarmac—sometimes becomes so constrained that cancellations are unavoidable. In managing these circumstances, airlines attempt to minimize disruptions to passengers and costs to themselves.

How an airline makes decisions within the context of this trade-off will vary among airlines depending on their business models and the particular situation at hand.

The DOT's tarmac delay rule requires airlines to limit the time flights spend on the tarmac to less than 3 hours or face the possibility of a substantial fine. Our hypothesis is that if the tarmac rule is associated with a greater incidence of flight cancellations, this may occur because the rule may have altered airlines' calculus in analyzing the trade-off between delay and cancellation. According to airline representatives we spoke with, flights that sit on the tarmac for a significant period of time may have to return to the gate to avoid a fine and, because of crew hour limits or because of the severity of the underlying cause of the delay, these flights may be canceled. In addition, airline officials and aviation stakeholders told us that the rule has increased the likelihood that they will precancel a flight—that is, cancel a flight before it ever leaves the gate. First, if a flight is returning to the terminal to avoid a tarmac fine, a flight that has not yet left the gate might need to be canceled to free gate space for the returning flight. Airline officials also told us that they are precanceling more flights before their scheduled departure time when weather or other factors indicate that long tarmac delays are possible. We were also told by one airline official that precancelations may be preferable if a long tarmac delay seems likely because passengers are likely to have more rebooking options if they are precanceled than if they wait for some time on the tarmac and attempt to rebook later in the day.

There are several limitations to this analysis. First, important factors related to cancellations may not be controlled for. For example, we do not have information on flights that were canceled for mechanical problems. This, along with other factors that might be relevant, could not be controlled for because we do not have adequate data to assess all factors that could be associated with cancellations. Also, the analysis provides a suggestion as to the factors that are correlated with cancellations, but does not necessarily suggest a causal relationship.

Estimation Method

To isolate the correlation between the rule and cancellations, as well as to better understand what other key factors are associated with the rate of cancellations, we developed two models to examine whether the rule may be correlated with a change in the incidence of flight cancellations. Because we are estimating the likelihood of a discreet event—whether a given flight is canceled—we applied a logistic regression (or logit method) for the estimation. This method enables us to assess how each of a set of independent factors correlates with the odds of a binary event—in this

case the cancellation or noncancellation of an airline flight. We examined two contexts in which a flight may be canceled, after some time on the tarmac or at the gate.[3]

Tarmac-cancellation model. In the first model, we assessed whether flights that left the gate were more likely to be canceled during May through September 2010 than during the same time period in 2009. Although the tarmac rule considers fines only for flights on the tarmac more than 3 hours, our discussions with airline officials and experts suggested that airlines begin to assess the risk of tarmac violation well before prolonged tarmac delay begins. We grouped flights into hour-long categories based on the amount of time a flight sat on the tarmac in order to assess whether the length of time on the tarmac is associated with the odds of cancellation. For example, if a flight sat on the tarmac for 72 minutes, we placed it in the 60 to 121 minutes tarmac time category. For the tarmac-cancellation model, we assessed 3,715,219 flight records for the 10 months included in the model; 1,799 of these were ultimately canceled.

Gate-cancellation model. In the second model, we examined whether flights were more likely to be precanceled after the rule went into effect. A precancellation occurs when a scheduled flight is canceled before it ever leaves the gate. Thus, even a flight that goes onto the tarmac but is later canceled is treated as a flight that was not canceled at the gate in this analysis. This model included 3,750,868 flight records, of which 35,649 were precanceled at the gate.

Many factors affect the possibility of a flight's cancellation and, therefore, we attempted to account for these other factors in the model. By controlling for this array of other influences on cancellations, the model is designed to determine whether the tarmac rule is independently correlated with the odds of a flight being canceled. Based on our research and discussions with airline representatives and academic experts, we identified factors that contribute to flight cancellations, including factors related to (1) the origin and destination airports, including circumstances at those airports at the time a flight is scheduled to depart, such as weather conditions; (2) characteristics of specific airlines and their

[3]The number of flights included in both the tarmac and gate-cancellation models are somewhat less than the number of flights used to develop the unadjusted odds ratio because some observations that had missing data were deleted from the logistic model.

operations; and (3) the scheduled city-pair route and the individual flight. Our hypothesis is that these same factors contribute to both types of cancellations, although we do not expect that the relationship between any of the factors and the odds of cancellation will necessarily be exactly the same in the two models. Each specific variable and its data source are discussed below.

Variables and Data Sources

The primary source of data for the model is flight level data from BTS's ASQP system. This system includes flight-level data, each record of which provides an array of information about a single-leg flight,[4] such as the origin and destination airports, the date and time the flight was scheduled to depart and arrive, the airline, the taxi-out time, cause of any delay, and whether the flight was canceled. The BTS data form the level of observation for the models—which is a given flight—and data from other sources are merged into these observations. Airlines that account for at least 1 percent of total domestic scheduled passenger service revenue are required to file this flight information with BTS. Because this required filing leaves out smaller airlines, not all flights are included in the model. Moreover, our analysis includes data for 70 airports. The remainder of this section describes the rationale for including each of the variables in the model, how each is calculated, and the source of the data.

The dependent variable. The dependent variable for the two models is a dummy variable—that is a variable that takes a value of one or zero depending on the presence or absence of some characteristic. For the tarmac-cancellation model this variable takes a value of one if a flight that left the gate returned to the gate after going onto the tarmac and then was canceled, and otherwise takes a value of zero. For the gate-cancellation model, the variable is set to one if the flight was canceled before taxiing out from the gate and is otherwise set to zero.

Variable of interest: implementation of tarmac delay rule. In both models, we include data on flights from May through September in 2009 and for the same months in 2010. Since the rule went into effect in late April 2010, a dummy variable indicating whether a flight took place in 2010 is used. For the tarmac model we also include a set of dummy

[4]Each observation is one flight segment. Many passengers change planes and have two or more segments on a one-way trip.

variables indicating how long a flight was on the tarmac before taking off or arriving back at the gate. We classify hour-long categories of tarmac time: 0 to 60 minutes, 61 to 120 minutes, 121 to 180 minutes, and more than 180 minutes, and include three dummy variables (using the 0 to 60 minute tarmac time as the reference category and therefore leaving it out of the regression) to test whether cancellations become more likely with longer tarmac times. Additionally, we multiply these three dummy variables by the dummy variable indicating whether the flight took place in 2009 or 2010. Creating such interactions allows the measured impact of the tarmac time on cancellation to be different before and after the implementation of the tarmac delay rule. Thus, we include six time-on-tarmac dummy variables in the tarmac delay model.

Variables related to airports and conditions at airports. Several of the independent factors that might affect the odds of a flight being canceled are related to the airports at which a flight begins and ends and certain conditions at those airports:

- *Dummy variables for congested airports.* It is well known that certain airports suffer more than others from congestion and delays. Because some airports have more delay-related issues, we believe that flights involving these airports may be more likely to be canceled, holding other factors constant. In a previous report we found that, according to FAA data, seven airports were the source of 80 percent of departure delays.[5] Because this issue could affect flights both on the tarmac and at the gate, we use two dummy variables in both models to denote whether a flight either started or ended at one of these seven airports. We expect that flights involving these airports are more likely to be canceled.

- *Endpoint airport weather conditions.* One of the factors likely to influence flight cancellations is the weather. Certain weather conditions can disrupt an airport's realized capacity level and cause traffic to flow more slowly or even halt for a time. We obtained data from the FAA for the National Oceanic and Atmospheric

[5]Specifically, according to data on delays occurring when flights are under FAA control, we found that 80 percent of departure delays across the national airspace system were due to conditions at just 7 of the 35 Operational Evolution Partnership airports—Newark Liberty International, New York LaGuardia, New York John F. Kennedy International, Chicago O'Hare International, Atlanta Hartsfield International, San Francisco International, and Philadelphia International. See GAO-10-542.

Administration's reporting of weather conditions for each hour at each of the airports included in our model. The data source provided information on the incidence of 32 types of weather conditions, such as fog, snow, thunderstorms, and hail. Additionally, FAA ranks each of the 32 weather conditions from 1 to 3 to indicate the impact of that particular weather condition on aviation activity. For example, thunderstorms can be highly disruptive to air traffic and is assigned a value of 3, while rain is assigned a value of 2, and haze a value of 1, indicating that haze usually presents only minor problems for air traffic. Using these data, we developed two variables to denote the occurrence of potentially disruptive weather conditions at the origin or the destination airport around the time a flight was scheduled for departure or arrival, respectively. In particular, to characterize the weather at the origin airport, we designated the hour of scheduled departure as the anchor timeframe, but we also took into account weather conditions in the hour before and the hour after the scheduled takeoff. This variable is set to 1 if a weather condition with a value of 3 (a significant weather condition) existed at the origin airport during the hour before, at the hour of, or the hour after the scheduled departure time. Similarly, the second variable is set to 1 if a weather event of value 3 occurred at the destination airport within the 3-hour window around the scheduled arrival time of the flight. Poor weather is expected to be associated with a greater likelihood of cancellation for flights already on the tarmac as well as those at the gate.

- *Ground delays and ground stops.* This variable considers whether FAA has initiated programs to slow or stop traffic at an airport because of weather conditions, congestion, or some other reason. We obtained data on such programs—either ground stops or delays—at all the airports in our sample, by hour, across the 10 months of our analysis. Using the scheduled departure hour, we created two dummy variables that were set equal to 1 if the origin or destination airports, respectively, had any program in place to slow or stop traffic at the hour that a flight was scheduled to depart. We expected that flights affected by a ground stop or ground delay program would be associated with greater odds of a flight cancellation both on the tarmac and at the gate.

- *Airport on-time performance.* A final measure that we included in the model to capture how well each airport is handling its scheduled traffic at a given point in time is the rate of the on-time performance. Data for this analysis come from the Aviation System Performance Metrics database maintained by FAA. We obtained on-time arrival and on-

time departure performance information for the airports in the model by hour.[6] In the model, a variable for the on-time departure performance for the origin airport is anchored at the hour of scheduled departure. Similarly, another variable is constructed for the on-time arrival performance at the destination airport. We expected that lower on-time performance measures would indicate difficulties in flowing the scheduled traffic and would thus be associated with a greater odds of flight cancellation.

Variables related to airlines and their operations. Some factors that might be correlated with the odds of a flight cancellation are related to the airline that is operating the flight and how the flight fits into that airline's network:

- *Size of airline.* Certain airlines may be more inclined to cancel flights than other airlines. We separated airlines into three categories: the legacy airlines, which are typically the larger networked airlines; low-cost airlines, which include Southwest and AirTran; and the smaller airlines, such as regional airlines, that tend to fly shorter routes with smaller aircraft and often operate flights for legacy airlines. We did not include the third airline classification in the model; instead we use it as the reference category against which the other two categories of airlines are compared.[7]

- *Airline hub*. Many airlines operate a network through which particular airports—called hubs—are used for the transfer of traffic so that a larger number of routes can be served. Even though our model looks at the odds of cancellation for a single leg flight and we do not examine itineraries of more than one flight leg, an airline considers, when deciding whether to cancel a flight, how its flights are interrelated and how passengers transfer among them. If a flight takes off from an airport that is a hub for the airline operating that flight, we deemed this an origin/hub flight. Likewise, if a flight is destined to an

[6]Data by airport was available for the 35 Operational Evolution Partnership airports and for the remaining airports the on-time performance for the entire national airspace at the relevant hours was used.

[7]The airlines classified as legacy included Delta Air Lines, United Airlines, American Airlines, US Airways, and Continental Airlines. Low-cost airlines included AirTran Airways, Alaska Airlines, JetBlue, and Southwest. The remaining airlines were grouped as "other."

airport that the carrier of record states is one of its hubs, we designated it as a destination/hub flight. If an airport is a hub for an airline, we expect this could affect the decision about whether to cancel a flight.

- *Average passengers per flight (on an airline-route basis).* This variable is designed to take into account the likelihood that airlines will attempt to deliver as many passengers as possible to their destination and so might be more inclined to cancel flights with fewer passengers onboard when circumstances disrupt traffic flow. Because data were not available on the number of passengers onboard each particular flight, we used the average number of passengers for a particular airline on a given route over the course of a month, divided by 10. Thus, the results indicate the change in the odds of cancellation for each additional 10 passengers on a given airline's flight for that route.

Variable related to the route and flight. The following variables provide information about the origin-to-destination route and the specific flight.

- *Route distance.* Some past research has shown that airlines are less likely to cancel longer distance flights.[8] We placed routes in four categories according to distance: less than 500 miles, and three categories that were more than 750 miles. We did not include the flights that fell into the 500 to 750 distance because it is the reference category that other distance dummy variables are compared to.

- *Day of the week.* Since traffic patterns vary across the days of the week, particularly weekdays versus weekend days, we included a dummy variable for flights that took place on the weekend. We expected that weekend flights will be canceled less often than weekday flights because less traffic is scheduled on the weekend making a given set of circumstances on the weekend less likely to disrupt traffic on these days.

- *Scheduled departure hour.* Airlines may be more or less reluctant to cancel flights at certain times of the day than at other times. For example, canceling early flights may be less problematic because there will be more options for rebooking passenger that day than there

[8]See, for example, Jing Xiong, *Revealed Preference of Airlines' Behavior Under Air Traffic Management Initiative*.

would be later in the day. Additionally, airlines may need to consider where an aircraft ends the day in preparation for the next day's traffic, and so may prefer not to cancel flights late in the day. We created four categories for departure hours: overnight, morning, afternoon, or evening. The afternoon category is not included in the model because it is the reference group we compare the three other dummy variables against.

Table 17 provides information on the source of data for each of the variables.

Table 17: Variables and Data Sources

Variable	Data source
Dependent variable: indicator that a flight was canceled	BTS data
Tarmac delay rule dummy variable	n/a
Indicator of length of time on tarmac (used as dummy variable and as interaction with tarmac delay dummy variable)	BTS data
Dummy variable for congested airports	Identified as seven airports with most delay, based on previous GAO report
Endpoint weather variable	National Oceanic and Atmospheric Administration weather data and FAA indicators of severity of weather conditions for aviation
Ground stops and ground delays	FAA's Operations Network data
Airport on-time performance	FAA Aviation System Performance Metrics data
Airline size categories	BTS Form 41 data on airline cost structures and previous GAO analysis
Airline hub airports	As identified by airlines
Average airline passengers per flight on a route	BTS Form 41 filings
Route distance	BTS data
Day of the week	BTS data
Scheduled departure hour	BTS data

Source: GAO.

Model Results

This section provides results for both the tarmac-cancellation and gate-cancellation models.

Results for Tarmac-Cancellation Model

We used output from the logistic regression model for the rule change dummy variable and the six dummy variables related to time on the tarmac to ascertain the relative odds of flight cancellations before and after the implementation of the tarmac rule. Table 18 shows, based on the model that controlled for other factors, how the odds of cancellation in each tarmac time category in 2010 compared with the odds of cancellation for the same tarmac time in 2009—specifically, we show the ratio of those odds. In all hour categories of tarmac time, the odds of cancellation were greater in 2010 than in 2009 because all of the odds ratios exceed 1. Moreover, the differential in the odds ratio of cancellations across the 2 years increased with the time a flight was on the tarmac. For flights that were on the tarmac for less than an hour, the odds of a cancellation were about one-third higher in 2010 than in 2009. But the longer a flight remained on the tarmac the more the relative odds of cancellation were greater in 2010 than in 2009. For flights with 61 to 120 minutes of tarmac delay, the odds ratio rose to 2.14, indicating that the odds of a cancellation more than doubled in 2010 compared with 2009, and for flights with 121 to 180 minutes of tarmac delay, the odds of cancellation more than tripled in that same time period. Finally, the odds ratios in table 18 are very similar to those presented in table 15, indicating that the inclusion of key variables to control for other factors did not have much effect on our findings related to the tarmac rule.

Table 18: Odds Ratios Estimates for Variables of Interest in Tarmac-Cancellation Model, 2010 versus 2009

Variable	Odds ratio; 2010 hour category compared with same hour in 2009
0–60 minutes on tarmac	1.31[a]
61–120 minutes on tarmac	2.14[a]
121–180 minutes on tarmac	3.59[a]

Source: GAO analysis of DOT data.

Note: Data for tarmac delays in excess of 3 hours are not included in the table because for 2010 the number of such delays was only eight and we decided that odds ratios based on such small numbers may not be representative.

[a]Denotes an odds ratio that is significant at the 1 percent level. The significance of the coefficients in the models we fit was evaluated using a simple Wald test statistic, which is asymptotically equivalent to the likelihood-ratio chi-square statistic. We regarded as significant all coefficients which yielded a test statistic with an associated probability of less than 1 percent, which means that there is less than a 1 percent probability of finding an effect (or association) as large as the one indicated by the estimated coefficient just by chance, or as a result of random fluctuations.

Table 19 provides the odds ratios from the logistic regression model for all other variables included in the tarmac-cancellation model. Some of the key findings are:

- Flights departing from or destined to an airline's hub airport are less likely to be canceled.
- Flights in evening hours are less likely to be canceled than flights departing in the afternoon.
- Flights of greater than 750 miles are less likely to be canceled than flights of 500 to 750 miles.
- Flights are more likely to be canceled if the departure airport or arrival airport is experiencing severe weather at or around the time of scheduled departure or arrival, respectively.
- Flights are more likely to be canceled if a ground stop or ground delay was in effect at either the departure airport or the arrival airport at the scheduled time of departure.

Table 19: Logistic Regression Results for Tarmac-Cancellation Model and Other Independent Variables

Variable	Odds ratio estimate
Departure airport is one of seven most congested, compared to all other airports	0.99
Destination airport is one of seven most congested, compared to all other airports	1.26[a]
Legacy airline, compared to smaller airlines	1.84[a]
Low-cost airline, compared to smaller airlines	0.24[a]
Weekend day, compared to weekday	0.86[a]
Scheduled departure in morning hours, compared to afternoon hours	1.04
Scheduled departure in evening hours, compared to afternoon hours	0.51[a]
Scheduled departure in overnight hours, compared to afternoon hours	1.08
Departure airport is a hub for airline	0.69[a]
Destination airport is a hub for airline	0.70[a]
Severe weather at departure airport around time of scheduled departure	1.45[a]
Severe weather at destination airport around time of scheduled arrival	2.87[a]
On-time performance, departures at departure airport	0.73[b]
On-time performance, arrivals at arrival airport	0.43[a]
Flight is less than 500 miles, compared to flights of 500–750 miles	1.09
Flight is 750–1,000 miles, compared to flights of 500–750 miles	0.77[a]

Variable	Odds ratio estimate
Flight is 1000–1500 miles, compared to flights of 500–750 miles	0.71[a]
Flight is 1,500 or more miles, compared to flights of 500–750 miles	0.60[a]
Average number of passengers per flight, by airline, route, and month (effect is per 10 passengers)	0.92[a]
Ground delay or stop in effect at departure airport around departure time	1.31[a]
Ground delay or stop in effect at destination airport around departure time	1.98[a]

Source: GAO analysis of DOT data.

[a]Denotes an odds ratio that is significant at the 1-percent level. The significance of the coefficients in the models we fit was evaluated using a simple Wald test statistic, which is asymptotically equivalent to the likelihood-ratio chi-square statistic. We regarded as significant all coefficients which yielded a test statistic with an associated probability of less than 1 percent, which means that there is less than a 1 percent probability of finding an effect (or association) as large as the one indicated by the estimated coefficient just by chance, or as a result of random fluctuations. It is not possible, strictly speaking, to characterize a logistic regression model in terms of the amount of variance in the dependent variable that is explained by the independent variables included in the model. We do note, however, that the percentage of canceled and noncanceled flights that are correctly classified using this model and the independent variables it includes is 86.3 percent.

[b]Denotes an odds ratio that is significant at the 5-percent level according to a Wald test statistic.

Results for the Gate-Cancellation Model

Table 20 provides the findings for the gate-cancellation model, which assesses the likelihood of precancellations, adjusted to account for factors other than the tarmac delay rule that may influence the incidence of cancellation. One significant finding is that the odds ratio for the rule change is substantially greater, when adjusted, than indicated by the simple unadjusted odds ratio shown in table 16. The model results indicate that the odds of gate cancellations rose by 24 percent after the rule went into effect, whereas the simple result indicated only a 13 percent increase in those odds. This suggests that to understand the independent correlation between the tarmac delay rule and likelihood of gate cancellation, it is important to control for the other factors that are likely correlated with such cancellations.

Findings from the gate-cancellation model suggest:

- Gate cancellations are more common when a flight is departing from or destined to one of the seven most congested airports in the U.S.
- Gate cancellations are less common for flights scheduled to depart in the evening, compared to flights departing in the afternoon.
- Gate cancellations are more common when severe weather is affecting either endpoint airport of a flight at the relevant hour.

- Gate cancellations are more common for very short flights, compared to flights of 500 to 750 miles in distance.
- Gate cancellations are less common for flights of a more than 750 miles, compared to flights of 500 to 750 miles.
- Gate cancellations are more common if a ground delay or ground stop was in place at the origin or destination airport at the time of scheduled departure.
- In this case it appears that flights to an airline's hub airport are more likely to be canceled.

Table 20: Logistic Regression Results for Gate-Cancellation Model and Other Independent Variables

Variable	Odds ratio estimate
Rule change dummy	1.24[a]
Departure airport is one of seven most congested, compared to all other airports	1.27[a]
Destination airport is one of seven most congested, compared to all other airports	1.33[a]
Legacy airline, compared to smaller airlines	1.57[a]
Low-cost airline, compared to smaller airlines	0.70[a]
Weekend day, compared to weekday	0.91[a]
Scheduled departure in morning hours, compared to afternoon hours	1.43[a]
Scheduled departure in evening hours, compared to afternoon hours	0.86[a]
Scheduled departure overnight hours; compared to afternoon hours	1.45[a]
Departure airport is a hub for airline	1.03
Destination airport is a hub for airline	1.34[a]
Severe weather at departure airport around time of scheduled departure	1.36[a]
Severe weather at destination airport around time of scheduled arrival	1.30[a]
On-time-performance, departures at departure airport	0.12[a]
On-time-performance, arrivals at arrival airport	0.15[a]
Flight is 0–500 miles, compared to flights of 500–750 miles	1.28[a]
Flight is 750–1000 miles, compared to flights of 500–750 miles	0.86[a]
Flight is 1000–1500 miles, compared to flights of 500–750 miles	0.88[a]
Flight is 1500 or more miles, compared to flights of 500–750 miles	0.57[a]
Average number of passengers per flight, by airline, route, and month (effect is per 10 passengers)	0.88[a]
Ground delay or stop in effect at departure airport around departure time	2.14[a]
Ground delay or stop in effect at destination airport around departure time	1.80[a]

Source: GAO analysis of DOT data.

[a]Denotes an odds ratio that is significant at the 1 percent level. The significance of the coefficients in the models we fit was evaluated using a simple Wald test statistic, which is asymtotically equivalent to the likelihood-ratio chi-square statistic. We regarded as significant all coefficients which yielded a test statistic with an associated probability of less than 1 percent, which means that there is less than a 1 percent probability of finding an effect (or association) as large as the one indicated by the estimated coefficient just by chance, or as a result of random fluctuations. It is not possible, strictly speaking, to characterize a logistic regression model in terms of the amount of variance in the dependent variable that is explained by the independent variables included in the model. We do note, however, that the percentage of canceled and noncanceled flights that are correctly classified using this model and the independent variables it includes is 75.8 percent.

Sensitivity Analysis

We ran the models using several other specifications, most of which involved alternative variable specifications. These runs indicated that our findings for the tarmac rule were robust across these specifications. Alternatives included the following:

- *Variations on how the specific airlines were grouped.* In the base case we classified airlines into three categories: legacy airline, low-cost airline, and all others. In an alternative specification, we classified airline as large or small based on the number of enplanements.
- *Variations for characterization of origin and destination airports.* In the base case models, we included dummy variables to indicate that the airport (origin or destination) was one of the seven most congested airports in the United States. In an alternative specification, we used 62 dummy variables to indicate whether the airport (origin or destination), was one of the 31 largest airports.
- *Alternative measure for poor weather conditions.* In the base case, we classified weather at endpoint airports as severe if a weather event occurring around the time of the flight would be considered highly disruptive to aviation activity. In an alternative specification we included both severe and moderately disruptive weather conditions.
- *Alternative distance measure.* In the base case, we classified distance into broad mileage categories. In an alternative specification, we entered distance divided by 100 as a continuous variable.
- *Elimination of flights that were canceled after a tarmac delay for the gate model.* For the gate model, we included flights that left the gate, even if they were later canceled. We did so because the airlines were attempting to get these flights off the ground when they were making gate-cancellation decisions, and so we treated these flights as nongate cancellations. In one sensitivity run, we eliminated any flights that left the gate but were later canceled.

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

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Staff Acknowledgments

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