United States Government Accountability Office

Report to Congressional Committees

September 2014

AVIATION

Impact of Fuel Price Increases on the Aviation Industry

GAO-14-331

GAO Highlights

Highlights of GAO-14-331, a report to congressional committees

September 2014

AVIATION

Impact of Fuel Price Increases on the Aviation Industry

Why GAO Did This Study

The aviation industry is vital to the U.S. economy. Passenger airlines directly generate billions of dollars in revenues each year and communities depend on passenger airlines to help connect them to the national transportation system. Between 2002 and 2013, jet fuel prices more than quadrupled from $0.72 to $2.98 per gallon and general aviation gasoline prices more than tripled from $1.29 to $3.93 per gallon in nominal terms. The Airport and Airway Trust Fund (trust fund) is funded principally by excise taxes on ticket purchases, aviation fuel, and cargo shipments as well as interest revenue. Section 808 of the FAA Modernization and Reform Act of 2012 required GAO to study the impact of increases in aviation fuel prices on the trust fund and the aviation industry in general.

This report discusses (1) the impact of increases in fuel prices from 2002 to 2013 on commercial passenger aviation, (2) the impact of increases in fuel prices from 2002 to 2012 on general aviation, and (3) the results of GAO's analysis of how future increases in fuel prices could impact the trust fund. GAO reviewed studies and other literature on the impact of fuel price increases. GAO conducted an analysis that included scenarios with increases in fuel prices up to 200 percent (as mandated by Section 808) through 2024. GAO also interviewed government officials and aviation associations. GAO is not making any recommendations in this report.

View GAO-14-331. For more information, contact Gerald L. Dillingham, Ph.D. at (202) 512-2834 or dillinghamg@gao.gov.

What GAO Found

Commercial passenger airlines have taken a number of steps aimed at mitigating the financial impact of the increases in fuel prices since 2002, according to aviation associations and government officials. Some airlines restrained the growth of their domestic seat capacity, others have reconfigured their fleets to make them more fuel efficient, conducted flight and ground operations more efficiently, improved aerodynamics, and reduced weight of items on-board aircraft. Airlines have also used fuel hedging, in which they enter into contracts that are designed to provide more certainty over the future price of fuel. Partly in response to financial pressures from increases in fuel prices, some airlines have merged or entered into route-sharing deals with other airlines. While these efforts coincided with increased fuel prices, an airline trade association identified other factors that contributed to these changes, such as a weak economy.

According to aviation associations and government officials, fuel price increases have contributed to a decline in general aviation activity (which is all non-scheduled air service), including the hours flown in general aviation aircraft. This decline in activity adversely affected general aviation airports and the services provided at these airports (such as reductions in flight training and refueling). For these activities and services, the price of fuel is not the only factor that contributed to this decline. According to associations that represent general aviation interests, a weak economy and other factors, such as increased security requirements, also contributed to the decline.

GAO's analysis shows that Airport and Airway Trust Fund revenues would grow marginally higher if fuel prices increased 200 percent from 2010–2024 compared to the growth under currently forecast fuel price increases because the projected increase in per-ticket revenue would outweigh the projected decrease in the number of tickets sold. However, the models for this analysis are limited and have greater uncertainty for later years. GAO contracted with IHS Global Insight to produce a model of macroeconomic variables, such as real gross domestic product (GDP), if fuel prices increased by 200 percent from 2010–2024 and GAO provided these outputs to FAA. FAA used the results and the rise in fuel prices to produce an alternative forecast of passenger traffic, which GAO then used to simulate annual trust fund revenues from 2010 through 2024 if fuel prices increased by 200 percent over that time. While this analysis allowed GAO to estimate how a hypothetical increase in fuel prices may affect growth in the trust fund, it is not a prediction of how the trust fund will actually grow in the next 10 years.

Refueling Commercial and General Aviation Aircraft

Sources: Multiflight (left) and National Air Transportation Association (right). | GAO-14-331

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Abbreviations

BTS	Bureau of Transportation Statistics
DOT	Department of Transportation
EIA	U.S. Energy Information Administration
FAA	Federal Aviation Administration
FBO	fixed-base operator
GAMA	General Aviation Manufacturers Association
GDP	gross domestic product
NATA	National Air Transportation Association
NEXTOR II	National Center of Excellence for Aviation Operations Research
SARS	Severe Acute Respiratory Syndrome

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

September 25, 2014

The Honorable John D. Rockefeller IV
Chairman
The Honorable John Thune
Ranking Member
Committee on Commerce, Science, and Transportation
United States Senate

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

The U.S. passenger airline industry is vital to the U.S. economy. Airlines directly generate billions of dollars in revenues each year and communities depend on passenger airlines to help connect them to the national transportation system, which links economies and promotes the exchange of people, products, and ideas. General aviation, which is all non-scheduled air service, includes important services such as medical transportation, disaster relief, and transportation access to rural and isolated communities, in addition to recreational flying.

For both passenger airlines and general aviation, the cost of fuel is an important component of operating costs. According to the U.S. Energy Information Administration (EIA), jet fuel prices more than quadrupled from $0.72 per gallon in 2002 to $2.98 per gallon in 2013 in nominal terms, and the price of aviation gasoline—another fuel used in general aviation—more than tripled from $1.29 per gallon to $3.93 per gallon over the same time period. [1]

Section 808 of the FAA Modernization and Reform Act of 2012[2] required GAO to study the impact of increases in aviation fuel prices on the Airport

[1]These prices are annual averages for kerosene-type jet fuel and aviation gasoline retail sales by refiners.

[2]Pub. L. No. 112-95, § 808, 126 Stat. 11, 122 (2012).

and Airway Trust Fund (trust fund) and on the aviation industry in general, including commercial passenger aviation, general aviation, and several related areas.[3] The mandate also required GAO to use the average aviation fuel price for fiscal year 2010 as a baseline and measure the impact of increases in aviation fuel prices that range from 5 percent to 200 percent over the 2010 baseline. As agreed with your offices, to meet the mandate's reporting deadline, we sent a letter to your offices in August 2012 providing our preliminary findings and explaining that we would subsequently issue a final report that would incorporate findings from relevant research that a team of three universities was conducting for the Federal Aviation Administration (FAA) at that time; this report is the final report as specified in that letter.[4]

This report discusses (1) the impact of increases in fuel prices from 2002 to 2013 on commercial passenger aviation, (2) the impact of increases in fuel prices from 2002 to 2012 on general aviation, and (3) the results of our analysis of how future increases in fuel prices could impact the trust fund.[5] To understand the impact of increases in fuel prices on commercial and general aviation, we analyzed data on aviation fuel prices, airlines' costs and revenues, and general aviation activity. All dollar figures in this report are nominal. We also reviewed relevant studies on the impacts of fuel price increases and interviewed officials from government, industry, and aviation associations to obtain their perspectives on how fuel price increases have impacted the industry. We selected these entities because they represent the relevant segments of the aviation industry and, based on our past work, are key associations. The information from these entities is not generalizable, but provided important insight for our work. To analyze the possible effects of increased fuel prices on the trust fund, we contracted with IHS Global Insight (Global Insight), a major

[3]The related areas specified in the mandate are piston aircraft purchase and use; the aviation services industry, including repair and maintenance services; aviation manufacturing; aviation exports; and the use of small airport installations.

[4]The three universities—the Massachusetts Institute of Technology, Virginia Tech, and the University of California at Berkeley—are part of FAA's National Center of Excellence for Aviation Operations Research (NEXTOR II). The universities, under the aegis of NEXTOR II, issued a final report to FAA in March 2014. See, National Center of Excellence for Aviation Operations Research (NEXTOR II), *The Impact of Oil Prices on the Air Transportation Industry*. March 28, 2014.

[5]We cover each of the related areas specified in the mandate under the two broad areas of commercial passenger aviation and general aviation.

macroeconomic forecasting firm, to run its forecast model of the U.S. economy under the assumption that fuel prices would increase 200 percent from 2010 to 2024. We provided FAA with the results of Global Insight's model, and FAA used those results as inputs to develop an alternative aviation activity forecast. We then used this aviation activity forecast to estimate the effect of the fuel price increase on trust fund revenues over the same time period.

To assess the reliability of data on fuel prices, airlines' costs and revenues, and general aviation activity, we reviewed the quality control procedures applied by the agencies that maintain these data. To assess the reliability of studies and FAA's forecast, a GAO economist reviewed their methodologies. We also spoke with Global Insight officials about the macroeconomic model to ensure that it was appropriate to use in our analysis. We determined that the data, studies, the Global Insight macroeconomic model, and FAA's forecast were sufficiently reliable for the purposes of this report.

We conducted this performance audit from March 2013 through September 2014 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

Commercial Passenger Aviation

The U.S. airline industry is principally composed of legacy, low-cost, and regional airlines. Legacy airlines—sometimes called network airlines—are essentially those airlines that were in operation before the Airline Deregulation Act of 1978.[6] These airlines support large, complex hub-and-spoke operations with thousands of employees and hundreds of aircraft of various types, with service at numerous fare levels to domestic communities of all sizes and to international destinations. Low-cost

[6]Pub. L. No. 95-504, 92 Stat. 1705 (1978).

airlines generally entered the marketplace after deregulation and tend to operate less costly point-to-point service using fewer types of aircraft. Regional airlines tend not to offer national service and generally operate smaller aircraft. Passengers access airlines in the United States through any of 517 commercial service airports—88 percent of passengers enplaned at the 63 largest airports in 2013, according to Department of Transportation (DOT) data.[7]

Since the airline industry was deregulated in 1978, its earnings have been volatile. In fact, despite considerable periods of strong growth and increased earnings, airlines have at times suffered such substantial financial distress that from 1979 through February 2014, there have been at least 196 airline bankruptcies, according to Airlines for America®, the trade association of major U.S. airlines. However, the industry as a whole has earned profits in the last few years. Some academics and industry analysts view the industry as somewhat unstable because of key demand and cost characteristics. Most notably, the demand for air travel is affected by the state of the economy as well as political, international, and even health-related events, but the cost characteristics of the industry can make it difficult for carriers to quickly match the supply of air service to rapidly shifting demand.

General Aviation

FAA divides general aviation activities into use categories. The largest of these categories is personal flying, which is defined as flying for pleasure or personal transportation and not for business purposes. In 2012, personal flying accounted for 39 percent of all general aviation hours flown, over two times more than the next largest segment—instructional flying. The other major use categories include corporate flying, which involves the use of an aircraft owned by a corporation or business and flown by a professional pilot; business flying, which refers to activities carried out in connection with the pilot's occupation or private business; and activities such as agricultural spraying. Figure 1 shows a general aviation aircraft being refueled.

[7]Commercial service airports are defined by 49 U.S.C. § 47102(7) as having scheduled service and enplaning 2,500 or more passengers each year. There are currently 63 large- and medium-hub airports.

Figure 1: General Aviation Aircraft Being Refueled

Source: National Air Transportation Association. | GAO-14-331

The general aviation fleet consists of about 209,000 active aircraft with an average age of about 35 years. Certain activities are generally associated with certain types of aircraft. For example, corporate flying generally involves the use of turboprop and turbojet aircraft; personal and instructional flying generally involve the use of small propeller aircraft. The largest category of aircraft is single-piston-engine propeller, which in 2012 made up 68 percent of the general aviation fleet.

The Trust Fund and Its Revenue Sources

Congress created the Airport and Airway Trust Fund in 1970 to provide a dedicated source of funding for the aviation system. The trust fund is funded principally by a variety of excise taxes paid by users of the national airspace system, as well as by interest revenue.[8] The excise taxes are imposed on airline ticket purchases and aviation fuel, as well as

[8]The trust fund accrues interest on its cash balance.

the shipment of cargo. These taxes are classified in seven categories or "tax lines," as shown in table 1.

Table 1: Airport and Airway Trust Fund Excise Tax Lines, Revenue Sources, and Current Rates

Tax line	Revenue source	Effective rate as of January 1, 2014
Transportation of persons by air	Tax on domestic passenger tickets	7.5 percent
	Tax on domestic flight segments (excluding flights to or from rural airports)[a]	$4.00 per passenger per segment; indexed to the Consumer Price Index
	Tax on mileage awards (frequent flyer awards tax)	7.5 percent of value of miles
Transportation of property by air	Tax on domestic cargo or mail	6.25 percent of the price paid for transportation of domestic cargo or mail
Use of international air facilities	Tax on international arrivals and departures	$17.50 per passenger; indexed to the Consumer Price Index
	Tax on flights between the continental United States and Alaska or Hawaii (or between Alaska and Hawaii)	$8.70 per passenger; indexed to the Consumer Price Index
Aviation fuel for commercial use	Tax on domestic commercial aviation fuel	$0.043 per gallon
Aviation fuel other than gasoline[b]	Tax on domestic general aviation jet fuel	$0.218 per gallon
Aviation gasoline	Tax on domestic general aviation gasoline	$0.193 per gallon
Liquid fuel - fractional ownership programs[c]	Surtax on fuel used in aircraft that is part of a fractional ownership program	$0.141 per gallon surcharge

Source: FAA and Internal Revenue Service data. | GAO 14 331

[a]A flight segment consists of one takeoff to one landing.

[b]26 U.S.C. §§ 4081, 9503(b)(1)(D), (c)(5) requires that taxes collected on kerosene used in aviation—previously deposited directly into the Airport and Airway Trust Fund—be initially deposited in the Highway Trust Fund and then transferred by accounting adjustments to the Airport and Airway Trust Fund.

[c]In a fractional ownership program, individuals or companies purchase a share in an aircraft for their occasional use.

The trust fund is used to fund FAA's capital programs and a substantial portion—between 43 and 67 percent over the last 5 years—of FAA's operations. FAA receives an appropriation from general revenues to fund the remaining portion of its operations. For fiscal year 2014, FAA's total appropriation was about $15.8 billion.

Increases in Jet Fuel Prices Have Contributed to a Variety of Impacts on Commercial Aviation

Higher Fuel Prices Have Increased Costs and Contributed to Lower Profitability for Airlines

According to EIA data, jet fuel prices more than quadrupled from $0.72 per gallon in 2002 to $2.98 per gallon in 2013. As a result, airlines' annual fuel-related costs more than tripled over the same time period, from about $14 billion to about $50 billion. Figure 2 shows a commercial aircraft being refueled.

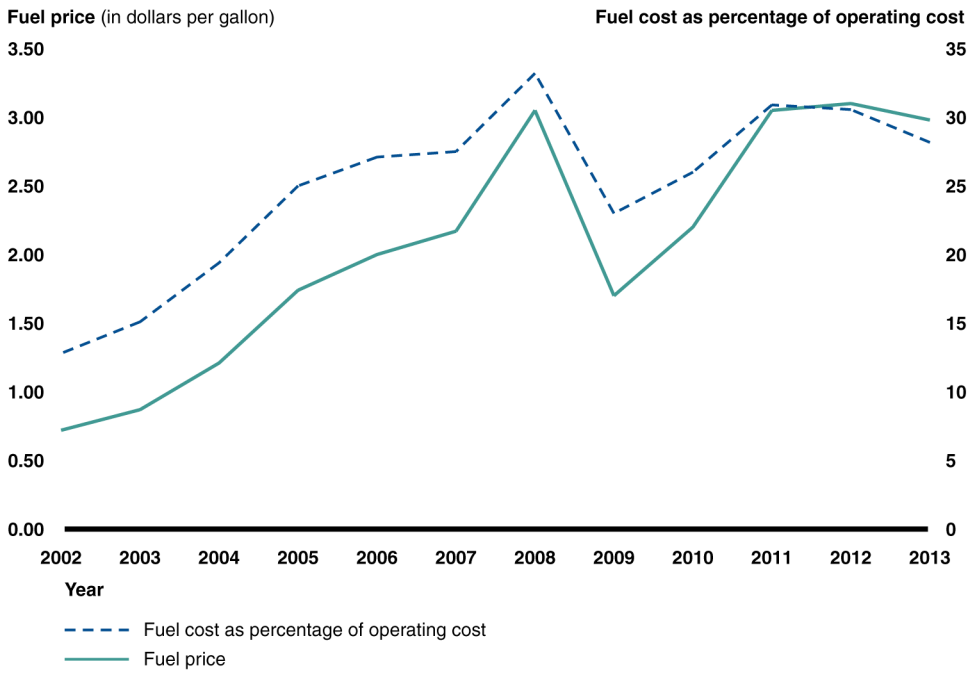
Figure 2: Passenger Aircraft Being Refueled

Source: Multiflight. | GAO-14-331

Over this time period, fuel became the largest component of airlines' operating costs—in 2002 fuel accounted for 13 percent of total operating

costs. As shown in figure 3, fuel accounted for 28 percent of operating costs in 2013.[9]

Figure 3: Price of Jet Fuel and Airlines' Fuel Costs as a Percentage of Total Operating Costs, 2002 to 2012



Sources: GAO analysis of Energy Information Administration and Department of Transportation data. | GAO-14-331

We and others have found that past increases in fuel prices, along with other key factors, reduced air carriers' earnings. Specifically, in 2009 we found that the sharp increase in the price of jet fuel in 2008 was the chief contributor to airline industry losses of about $4.3 billion in the first three

[9]Changes in other components of airlines' operating costs can affect fuel costs as a share of operating costs, and vice versa. For example, in its February 2010 economic briefing report, the International Air Transport Association stated that the decline in labor's share of total operating costs for North American airlines from 2001 through 2008 reflected both the sharp rise in fuel costs and lower labor costs. According to the association, the lower labor costs were a result of significant improvements in labor productivity and some cases of lower pension liabilities associated with Chapter 11 bankruptcies. The lower labor costs, in addition to higher fuel costs, helped increase fuel's share of total operating costs.

quarters of 2008.[10] We found that lower demand for air travel due to the weakening economy was also a contributing factor to these losses. In 2012, the Bureau of Transportation Statistics (BTS) found that "fuel price increases over the past decade coincided with reduced profits and, in many cases, operating losses among carriers."

In several annual reports and press releases on the airline industry's economic results, Airlines for America®, the trade association of major U.S. airlines, said that increases in fuel prices contributed to industry-wide annual losses in 2003 ($3.6 billion), 2004 ($9.1 billion), 2005 ($5.7 billion), and 2008 ($9.5 billion). The association cited other factors as contributing to the losses, including the war in Iraq and the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2003 and the global economic recession in 2008. The association also stated that profits of passenger airlines fell from about $2.7 billion in 2010 to about $390 million in 2011 and $264 million in 2012[11] due largely to increases in the annual average price of jet fuel, along with one-time charges associated with bankruptcy filings. In addition, the association stated that despite increases in fuel prices, the industry was able to earn net profits of $3.0 billion in 2006 and $5.0 billion in 2007 due partly to savings from fuel conservation programs along with increases in revenues from a combination of higher passenger traffic and higher airfares. Finally, the association reported that passenger airlines had a combined net profit of $7.4 billion in 2013.[12]

Airlines Have Responded to Increases in Fuel Prices by Attempting to Increase Revenues and Restraining Capacity Growth

Airlines attempt to recoup the higher costs associated with high fuel prices by increasing revenues, which can be either through fare increases or increases in other fees. According to FAA, airlines have increased fares in some years that saw increased fuel prices, but lowered fares in other such years. Specifically, FAA said that, even though fuel prices increased, airlines decreased domestic fares in 2003 and 2004, largely due to increased competition from low cost carriers. In contrast, FAA said

[10]GAO, *Commercial Aviation: Airline Industry Contraction Due to Volatile Fuel Prices and Falling Demand Affects Airports, Passengers, and Federal Government Revenues*, GAO-09-393 (Washington, D.C.: Apr. 21, 2009).

[11]These data represent the 11 largest passenger airlines in 2010 and 2011 and the 10 passenger airlines that had reported full-year financial results as of February 2013.

[12]These data represent the 9 passenger airlines that had reported full-year financial results as of March 2014.

that airlines increased fares in several years in which fuel prices increased from 2005 through 2012. In 2008, in addition to increasing fares, airlines began to charge for many services for which separate charges did not previously exist. These services include fees for a checked bag, early boarding, or other amenities. These fees are not included in the fares directly charged for transporting passengers and are commonly known as ancillary fees. Under governing Treasury Regulations and Internal Revenue Service guidance, ancillary fees for optional services are not subject to any excise tax. As a result, such fees do not generate revenue for the trust fund. Other ancillary fees, such as those for reservation changes or oversized baggage, have existed for many years. In 2002, legacy airlines derived 1 percent of their revenue from ancillary fees for reservation changes or baggage.[13] In 2013, legacy carriers derived more than 4 percent of their revenue from these fees.[14]

Airlines have taken a number of steps aimed at mitigating the financial impact of the increases in fuel prices that occurred from 2002 through 2013. High fuel prices may contribute to airlines reducing capacity, or restraining growth in capacity, to control costs and help maintain or increase fares by limiting the supply of airline seats relative to the demand. The 2014 NEXTOR II report concluded that available data suggest that airlines restrained growth in their domestic capacity between 2004 and 2007 in response to higher fuel prices. More specifically, the study concluded that the growth in domestic capacity during the time period (1.6 percent, measured in available seat miles) was much smaller than would be expected had fuel prices not increased substantially, given that U.S. gross domestic product and commercial passenger aviation

[13]Ancillary fees for reservation changes and baggage are the only ancillary fees that airlines must report separately.

[14]In 2013, baggage fees included some fees that did not exist in 2001, including fees for first and second checked bags. If baggage fees alone had been subject to a 7.5 percent excise tax in fiscal year 2010, the trust fund would have received approximately an additional $248 million in revenues. We have suggested that if Congress determines that the benefit of added revenue to the trust fund warrants taxation of these fees, then it should consider amending the Internal Revenue Code to mandate the taxation of airline-imposed fees and require that the revenue be deposited in the trust fund. As of February 2014, Congress had not taken action regarding this matter. See *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). See also *Airport and Airway Trust Fund: Declining Balance Raises Concerns over Ability to Meet Future Demands*, GAO-11-358T (Washington, D.C.: Feb. 3, 2011).

traffic both grew substantially over roughly the same time period. We reported that airlines reduced domestic capacity by 9 percent from the fourth quarter of 2007 to the fourth quarter 2008, partly in response to an increase in fuel prices and partly in response to the economic recession.[15]

Airlines Have Improved Fuel Efficiency and Taken Other Steps to Help Cope with Higher Fuel Prices

In recent years, airlines have taken a number of steps to improve their fuel efficiency in an effort to mitigate the impact of fuel price increases on their costs. For example, according to FAA, legacy and low-cost carriers retired older, less fuel efficient aircraft (e.g., Boeing 737-300/400/500 and McDonnell Douglas MD-80) and replaced them with more technologically advanced Airbus A320 and Boeing 737-700/800/900 aircraft. As airlines replaced their less fuel-efficient aircraft with more fuel-efficient aircraft, manufacturers saw increased orders for their new, more fuel-efficient models. For example, in its 2007 annual report, Boeing stated that high fuel prices, among other factors, had spurred strong demand for new, more fuel-efficient aircraft—over 7,000 orders for large commercial jet aircraft over the previous 4 years. In its 2012 annual report, United Technologies, parent company of aircraft engine manufacturer Pratt & Whitney, cited demand for new fuel efficient engines in the face of high fuel prices as a major reason for its significant investments in engineering and development of five new turbofan engine platforms. According to an official from the Aeronautical Repair Station Association, the replacement of older, less fuel-efficient aircraft with newer more fuel-efficient aircraft adversely affected independently owned maintenance, repair, and overhaul businesses because older aircraft are serviced primarily by such businesses. The official added that the impact was particularly acute from the sharp increase in fuel prices in 2008, with some businesses laying off mechanics and a few others going out of business.

According to Airlines for America®, airlines also began operating their planes in more fuel-efficient ways, including flying more slowly, taxiing using one engine instead of two, and installing winglets—wing extensions that reduce drag. According to the association, airlines also reduced and reconfigured the weight of items on board aircraft, by, for example, removing seatback phones and galley equipment such as ovens and trash compactors; carrying less fuel and water and fewer magazines; and

[15]GAO-09-393.

distributing cargo so that the aircraft had a more fuel-efficient center of gravity.

As we reported in 2009, airlines have also used fuel hedging, in which they enter into varied types of contracts that are designed to provide more certainty over the future price of fuel and thus help to manage the airlines' future costs.[16] The fuel hedging strategies that airlines used were initially beneficial in 2008 because the contracts they had entered into gave them protection against increases in the price of fuel, which occurred in early 2008 through the summer. However, when fuel prices tumbled rapidly to about one third of the year's highest price at the end of 2008, many airlines incurred substantial losses because their hedging strategies involved substantial downside risk—that is, they were exposed to financial losses in the event of a sharp decline in the price of fuel.

Airlines have taken other steps partly in response to higher fuel prices. In 2012, Delta Air Lines purchased an oil refinery for the stated purpose of capturing the markup that producers charge to refine a barrel of oil into jet fuel and thereby reduce its annual fuel expense and to ensure fuel availability in the Northeast. However, these strategies entail some risk. According to CAPA Centre for Aviation, Delta lost about $100 million on this investment in 2013, in part because production at the refinery was disrupted for several months after Hurricane Sandy struck the east coast in October 2012. Airlines have also partnered with FAA, aviation manufacturers, and other industry participants to help accelerate commercial development and production of alternative jet fuels that are designed to decrease fuel cost while enhancing environmental sustainability for commercial aviation. We issued a separate report on alternative jet fuels earlier this year.[17]

[16]GAO-09-393.

[17]GAO, *Alternative Jet Fuels: Federal Activities Support Development and Usage, but Long-Term Commercial Viability Hinges on Market Factors*, GAO-14-407 (Washington, D.C.: May 7, 2014).

Higher Fuel Prices Have Been a Factor in Airline Mergers and Job Cuts and Have Contributed to Airline Bankruptcies and Failures

Partly in response to financial pressures from increases in fuel prices, some airlines have merged or entered into route-sharing deals with other airlines. For example, prior to the merger of Delta and Northwest in 2008, Delta stated that merging the airlines was "the most effective way to offset higher fuel prices and improve efficiencies, increase international presence and fund long-term investment in the business." In 2013 we found that given recent economic pressures, particularly increased fuel costs, the opportunity to lower costs by reducing redundant capacity was one of several financial benefits to shareholders that drive airlines to merge.[18] In 2009, we also found that seven smaller airlines ceased operations and other airlines entered bankruptcy during the first half of 2008, in large part because of the increases in fuel prices that occurred in 2007 and 2008 and also because of the weak economy.[19]

Airline employment was also impacted by increasing fuel costs. From December 2002 through December 2013, airline employment fell from about 422,000 to about 325,000, or about 23 percent.[20] According to Airlines for America®, these reductions were largely due to the financial pressures airlines felt from high fuel prices and from reduced demand for passenger travel related to the September 11, 2001 terrorist attacks, the outbreak of SARS in 2003, and a weak economy in 2008 and 2009, among other factors.

Airports were also adversely affected by the reductions in capacity that airlines made in 2008 in response to high fuel prices and a weakening economy. For example, in 2009 we found that as a result of the capacity reductions, 38 airports that served small communities lost all scheduled air service from the fourth quarter of 2007 to the fourth quarter of 2008.[21] We noted that small communities often rely on aircraft of 50 or fewer seats—which are less fuel efficient than larger aircraft—for service, and

[18]GAO, *Airline Mergers: Issues Raised by the Proposed Merger of American Airlines and US Airways*, GAO-13-403T (Washington, D.C.: June 19, 2013).

[19]GAO-09-393. In 2008, Air Midwest, Aloha Airlines, ATA Airlines, Champion Air, EOS Airlines, Big Sky Air, and Skybus Airlines ceased operation, while Frontier and Sun Country filed for Chapter 11 bankruptcy but are still operating.

[20]These employment figures do not include regional airlines because many regional carriers were not required to report employment numbers before 2003.

[21]We also found that 8 of these 38 airports had service restored by February 2009 and 6 others were scheduled to have service restored by May 2009. See GAO-09-393.

that airlines' capacity reductions included removal of many of these smaller aircraft from their fleets. We also found that some airports experienced traffic reductions of more than 25 percent from the fourth quarter of 2007 to the fourth quarter of 2008. Finally, we found that airport revenues declined as a result of declines in passenger traffic, prompting airports to delay capital improvement projects, lay off employees, and freeze hiring; an FAA airports official added that some airports deferred maintenance. In addition to our report, in 2011, DOT's Future of Aviation Advisory Committee noted that as a result of the sharp increase in fuel prices, 61 of 67 large- and medium-hub airports experienced a decrease in domestic departures in the fourth quarter of 2008 compared with the fourth quarter of 2007.

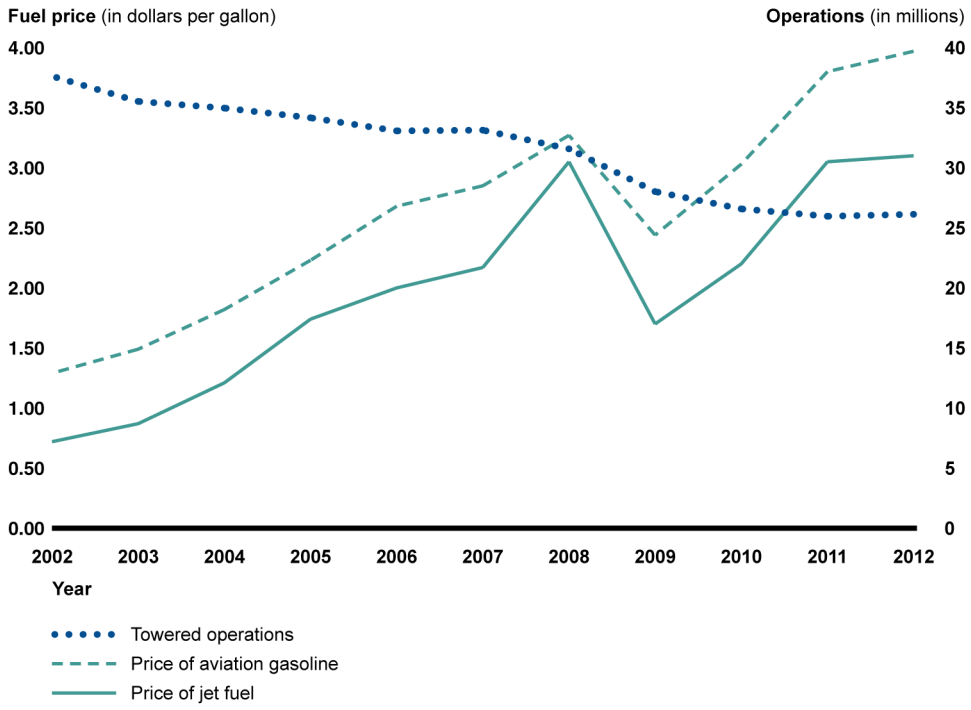
Increases in Fuel Prices Have Contributed to a Decline in General Aviation Activity

Increases in Fuel Prices Resulted in Higher Costs for General Aviation Operators, Contributing to a Decline in General Aviation Activity and Aircraft Sales

According to several sources, increases in fuel prices have reduced general aviation activity. From 2002 to 2012, the prices of the two types of fuel used by general aviation increased substantially, with jet fuel prices more than quadrupling from $0.72 to $3.10 per gallon and aviation gasoline prices more than tripling from $1.29 per gallon to $3.97, according to EIA data; according to FAA, over the same time period, the annual number of general aviation operations (takeoffs or landings) at airports with an active air traffic control tower decreased from about 38 million to about 26 million (31 percent).[22] (See fig. 4.)

[22]We used operations at airports with an active air traffic control tower to measure general aviation activity because it is the most reliable such measure available. However, many general aviation operations are conducted at airports that do not have an air traffic control tower. FAA's most recent data available on general aviation operations is for 2012. For consistency, we used fuel price data through 2012 even though 2013 data are available.

Figure 4: Price of General Aviation Fuel and Number of General Aviation Operations, 2002-2012



Source: GAO analysis of Energy Information Administration (EIA) and FAA data. | GAO-14-331

According to several sources, high fuel prices are one of several factors that contributed to a decline in general aviation activity. A 2012 study by the Massachusetts Institute of Technology found that, in addition to increases in fuel prices, these factors included the 9/11 terrorist attacks; the economic recession from December 2007 to June 2009; increased use of internet in business as a substitute for business travel; and a decline in the pilot and aircraft populations, with fewer student pilots, on average an older pilot population, more expensive new aircraft, and an older active aircraft population. Furthermore, the Aircraft Owners and Pilots Association, the National Business Aviation Association, the General Aviation Manufacturers Association (GAMA), and the National Air Transportation Association (NATA) have all stated that higher fuel prices have contributed to reductions in hours flown by general aviation users. Several of these associations also cited a weak economy as contributing to declines in general aviation activity. FAA has cited increased security requirements as another factor.

According to FAA, from 2002 to 2012 the number of operating piston aircraft declined 11 percent and the average hours flown per aircraft dropped by 21 percent.[23] In 2011, FAA stated that the decline in the use of piston engine aircraft was partially due to rising fuel costs. Similarly, a 2013 study by Virginia Polytechnic Institute and State University concluded that increases in fuel prices reduce the utilization of piston aircraft and that the health of the economy is also an important factor in the use of piston engine aircraft.

According to officials with GAMA, increases in fuel prices contributed to decreases in sales of general aviation aircraft. The officials said that fuel prices are the second most important driver of the level of aircraft sales, behind the health of the economy. In 2009, NATA officials stated that although jets were continuing to dominate business aircraft production, the high cost of fuel was causing a number of general aviation operators to look again at turboprops, largely due to their higher fuel efficiency.

Increases in Fuel Prices Adversely Affected General Aviation Airports

According to several sources, the decrease in general aviation activity from 2002 to 2012 had an adverse impact on general aviation airports and the services offered at these airports. For example, according to a 2008 report by an energy task force of the American Association of Airport Executives, recent sharp increases in fuel prices had a severe impact on general aviation airports, fixed-base operators (FBO),[24] and charter companies. NATA officials told us that increases in fuel prices in 2008 and 2009, along with a weak economy, contributed to reductions in business for FBOs, flight schools, and on-demand charters. These officials said that fuel price increases led FBOs to consolidate - the number of FBOs fell from 3,400 in 2007 to less than 2,900 in 2012 – and to form networks to pool their resources and increase their purchasing and negotiating power to reduce the prices they pay their suppliers for fuel and other products. NATA also told us that increases in fuel prices

[23]FAA develops annual estimates of active aircraft and flight hours based on the agency's survey of general aviation operators. While we have expressed concerns about the quality of FAA's survey data, we determined that FAA's estimates of active aircraft and flight hours are reliable indicators of overall trends in general aviation activity. See GAO, *General Aviation Safety: Additional FAA Efforts Could Help Identify and Mitigate Safety Risks*, GAO-13-36 (Washington, D.C.: Oct. 4, 2012).

[24]A fixed-base operator provides a variety of services to pilots, such as flight training, aircraft rental, fueling, maintenance, parking, and the sale of pilot supplies.

combined with a weak economy caused more aircraft owners than usual to keep their old planes rather than purchasing new planes, resulting in increased business for aircraft maintenance, repair, and overhaul companies.

Our Analysis Suggests Little Change in Trust Fund Revenues If Fuel Prices Increase, but Effects from Underlying Models Are Uncertain

While activity across several sectors of the aviation industry—including cargo and general aviation—affects the revenue of the trust fund, our analysis focused on taxes and fees paid for commercial passenger travel, which make up about 90 percent of trust fund revenues. Revenues from commercial passenger travel consist of several taxes and fees including: (1) the domestic ticket tax, which is applied as a percentage of each passenger's ticket price;[25] (2) the domestic segment tax, which is levied as a set amount per flight segment flown; and (3) taxes on international departures and arrivals and on flights between the lower 48 states and destinations in Hawaii and Alaska or between those two states.[26]

- Ticket tax: If airline ticket prices increase due to higher fuel costs, then the amount to which the ticket tax is applied increases. As a result, the tax receipt for a given ticket will rise because the ticket tax is a percentage of the ticket price. However, because fewer passengers would be expected to fly after a ticket price increase, the ticket tax would be collected on fewer tickets. Whether total ticket tax revenues rise or fall would depend on the interplay between these two effects.
- Segment taxes and international and Hawaii/Alaska arrival and departure taxes: These fees are levied per flight-segment or per arrival/departure and would be expected to fall if ticket prices increase because fewer people would choose to fly.

Based solely on the influence of higher ticket prices due to a fuel price increase, trust fund revenues could rise or fall. While segment fees would fall due to reduced travel induced by higher fares, the ticket tax revenue could either rise or fall depending on whether the reduction of people travelling outweighs the higher tax collected per traveling person. If revenues from both the ticket tax and segment taxes decline due to an increase in fuel prices, then total tax revenues would also decrease. If ticket tax revenues increase and the segment tax reductions outweigh that increase, then total tax revenues would decrease. However, tax

[25]26 U.S.C. § 4261(a).

[26]26 U.S.C. § 4261(b).

revenues would increase if an increase in ticket tax revenues exceeds the decrease in segment tax revenues.

In addition to the effect that a fuel price increase would directly have on the amount of aviation traffic through higher ticket prices, an increase in fuel prices could also indirectly affect the amount of aviation traffic through its effects on the broader economy. For example, fewer people may choose to fly if the economy were growing more slowly and the unemployment rate were to rise after a fuel price increase. In addition, the influence of higher fuel prices on the prices of other products—such as food and gasoline—may also affect demand for airline service. As a result, the broader economic effects could have an additional influence on the commercial passenger tax revenues beyond the specific effect that a rise in fuel prices would have on ticket prices.

We examined how a fuel price increase might influence passenger traffic both directly and via its effect on the macroeconomic environment. To do this analysis, we performed three steps:

1. We contracted with Global Insight to run an alternative to its baseline forecast of various macroeconomic variables under the assumption that the price of fuel steadily increases each year from 2014 to 2024 so that the price will be 200 percent higher in 2024 than it was in 2010. This price increase—the only variable we asked to be changed—is more rapid than in Global Insight's baseline forecast.[27] Based on this alternative assumption, Global Insight modeled the effects on the future values of several key macroeconomic variables, such as the level of real gross domestic product (GDP), consumer disposable income, and the unemployment rate.
2. We provided the macroeconomic outputs of Global Insight's model to FAA, and FAA input those results, along with the higher fuel price, into its existing models to develop an alternative forecast of enplanements—the number of people boarding commercial aircraft—from 2014 to 2024. FAA's forecast takes into account the effect of fuel prices on enplanements through the impact on airlines' operating costs—which affect ticket prices—as well as the indirect effects on

[27]Global Insight used the weighted average price of crude oil received in refinery inventories as a proxy for the price of jet fuel. FAA uses Global Insight's baseline macroeconomic model to develop their base case aviation activity forecast.

enplanements through broader macroeconomic variables—such as GDP and unemployment—that are modeled by Global Insight.

3. We used FAA's forecast of aviation activity under higher fuel prices and its base case forecast to calculate and compare the trust fund's receipts under each scenario over the next 10 years. We refer to the forecast under higher fuel prices as the "high fuel-price scenario."[28]

Our analysis shows that the trust fund revenues grow at a marginally higher rate of 4.9 percent annually under the high fuel price scenario compared with 4.6 percent annual growth under the base case. This occurs because, in comparing the high-fuel price and base-case scenarios, the increase in ticket tax revenues in the high-fuel price scenario is greater than the decrease in segment tax revenues.[29] The higher fuel prices cause the level of domestic enplanements to be only slightly lower than under the base case. As a result, slightly less segment tax revenues are generated under the high fuel-price scenario compared with the base case scenario. However, the higher fuel prices result in higher ticket prices, and therefore higher ticket-tax revenue per ticket; since the decrease in enplanements is small, this per-ticket increase outweighs the decrease in the number of tickets sold and ticket tax revenue increases.[30] Ultimately, the increase in ticket tax revenues is greater than the decrease in revenue from segment taxes, so trust fund revenues from commercial passenger travel increase in the high fuel

[28]FAA does not forecast trust fund receipts but issues forecasts of aviation demand. The U.S. Department of the Treasury does an official forecast of trust fund revenues based partly on its own forecast of aviation demand. We used FAA's forecast of aviation demand because it is the official government forecast of aviation activity, which was the data element needed for our analysis. The specific values of our trust fund estimates for both the base case and the high fuel-price scenarios are only general estimates and not tied to the official Treasury trust fund estimate. For purposes of this report the relevant issue is the differential between the base case estimate and the alternative estimate, and not the specific forecast amounts.

[29]Our analysis included all commercial passenger taxes, such as the tax on international arrivals and departures, and not just the ad valorem and segment taxes. International tickets are taxed as a set amount per ticket, so revenue from this tax rises or falls as international enplanements rise or fall. This tax brought in less revenue than in the base case in the early years of the forecast because international enplanements are lower than in the base case. In later years of the forecast, revenue from this tax is higher because international enplanements are higher than in the base case.

[30]Although we do not directly observe the change in ticket prices under the high fuel-price scenario, we can infer that ticket prices increased because passenger revenues are higher despite the decline in enplanements.

price scenario. This result is driven by the limited reduction in enplanements in the high fuel price scenario.

The limited reduction in enplanements appears to be mainly driven by the manner in which the economy adjusts to higher fuel prices over the 10-year time frame in the Global Insight model. Under the high fuel-price scenario, key variables that are inputs into FAA's enplanement model—including real GDP, consumer disposable income, and the unemployment rate—are affected by the higher fuel price. During the first few years of the forecast, those changes reflect a softening economy due to the fuel price increase. However, the model suggests that the economy would adjust to rising fuel prices within a few years. As a result, the model predicts that GDP, disposable income, and unemployment ultimately return close to their values in the baseline model. According to Global Insight representatives, this is because their model assumes that the rising price of fuel engenders an increase in domestic exploration for oil and gas and thus expands this industry. This expansion, along with those in related industries and an associated rise in exports, are the key reasons for the strength of the economy in the later years of the high fuel price scenario.[31] Due to the strength of the economy, there is only a modest decline in FAA's enplanement forecast as a result of rising fuel prices.

Our analysis allows us to illustrate how a hypothetical increase of 200 percent in jet fuel prices may affect growth in trust fund revenues relative to those derived from FAA's current projections of aviation activity. The results of our analysis are not predictions of how the trust fund will actually grow or what the total revenues are going to be in the next 10 years. Instead, they provide some indication of the extent to which we might expect trust fund revenues to be influenced by higher fuel prices.

There are limitations and caveats for all economic models. No model can take into account every possible event or policy change that may occur in the future. In particular, economic models tend to be better at forecasting the near future than later years. As a result, the longer the forecast, the less confidence there is in the results. In particular, if the overall adjustment to higher fuel prices built into the Global Insight model did not

[31]Similarly, while consumer disposable income declines and the unemployment rate rises in the early years of the high fuel price scenario, these variables return to values close to the baseline forecast in the later years of the high fuel price scenario.

happen to the extent indicated in its analysis, the effect of the rising fuel prices on the aviation sector and the trust fund would be somewhat different.

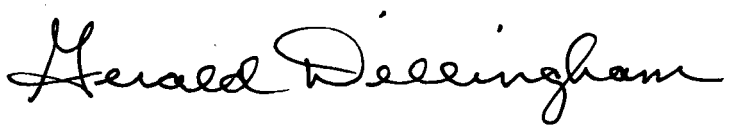
Agency Comments

We provided DOT with a draft of this report for review and comment. DOT provided technical comments, which we incorporated as appropriate.

In addition, to verify information, we sent relevant sections of the draft report to the Department of Treasury, the Department of Energy, the Department of Commerce, Airlines for America®, and the Aircraft Owners and Pilots Association, several of which also provided technical comments that we incorporated as appropriate.

We are sending copies of this report to the Secretary of Transportation, relevant congressional committees, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me on (202) 512-2834 or at dillinghamg@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 III.



Gerald L. Dillingham, Ph.D.
Director, Physical Infrastructure Issues

Appendix I: Scope and Methodology

To understand the impact of increases in fuel prices from 2002 to 2013 on commercial passenger aviation, we analyzed data on jet fuel prices and on airlines' costs and revenues as well as reviewed relevant literature and interviewed officials from government, industry, and aviation associations. We analyzed the Department of Energy's Energy Information Administration's (EIA) data on average annual prices for U.S. kerosene-type jet fuel retail sales by refiners for 2002 through 2013. All dollar figures presented throughout this report are in nominal terms. We analyzed data on airlines' total operating costs and fuel costs, as well as their revenues from ancillary fees, from the Department of Transportation's (DOT) Form 41 financial data submitted to DOT by airlines from the years 2002 through 2013, the last full year available. We obtained these data from Diio, a private contractor that provides online access to U.S. airline financial, operational, and passenger data with a query-based user interface. To assess the reliability of these data, we reviewed the quality control procedures used by EIA, Diio, and DOT and subsequently determined that the data were sufficiently reliable for our purposes. We also reviewed a study performed by a team of three universities for the Federal Aviation Administration (FAA),[1] industry reports and other industry literature, and our own previous studies. A GAO economist reviewed the study and determined that it was sufficiently reliable for the purposes of this report. Finally, we conducted interviews with officials from DOT, FAA, EIA, and the Department of Commerce's International Trade Administration; a large aircraft manufacturer; airline trade associations, airports associations, and a maintenance, repair, and overhaul trade association. We selected these entities because they represented the relevant segments of the aviation industry and, based on our past work, are key associations. The information from these entities is not generalizable, but provided important insight for our work.

To understand the impact of increases in fuel prices from 2002 to 2012 on general aviation, we analyzed data on general aviation fuel prices and on general aviation activity, reviewed relevant studies and other literature, and interviewed government and industry officials.[2] We analyzed EIA's

[1]The three universities—the Massachusetts Institute of Technology, Virginia Tech, and the University of California at Berkeley—are part of FAA's National Center of Excellence for Aviation Operations Research (NEXTOR II). The universities, under the aegis of NEXTOR II, provided a final report to FAA on March 28, 2014.

[2]FAA's most recent data available on general aviation operations, the measure we used for general aviation activity, is for 2012. For consistency, we used fuel price data through 2012 even though 2013 data were available.

data on average annual prices for 2002 through 2012 related to the two types of fuel used by general aviation: U.S. kerosene-type jet fuel retail sales by refiners and U.S. aviation gasoline retail sales by refiners. We also analyzed data from FAA's Operations Network system on general aviation operations conducted under the supervision of an air traffic control tower. To assess the reliability of these data, we reviewed the quality control procedures used by EIA and DOT and subsequently determined that the data were sufficiently reliable for the purposes of this report. We also reviewed academic studies and industry literature. A GAO economist reviewed the studies and determined that they were sufficiently reliable for our purposes. Finally, we conducted interviews with officials from DOT and FAA; a general aviation aircraft manufacturer; and general aviation users associations, a general aviation manufacturer's trade association, airports associations, and an association representing general aviation service businesses such as fixed base operators and maintenance and repair businesses. We selected these entities because they represented the relevant segments of the aviation industry and, based on our past work, are key associations. The information from these entities is not generalizable, but provided important insight for our work.

To analyze the possible effects of increased fuel prices on the trust fund, we contracted with IHS Global Insight (Global Insight), a major macroeconomic forecasting firm, to run their model of the U.S. economy under the assumption that fuel prices would increase steadily from 2014 to 2024 so that the price rises to 200-percent higher in 2024 than it was in 2010. To develop this model, Global Insight used the price of crude oil as a proxy for the price of jet fuel, as jet fuel prices are closely correlated with crude oil prices. Global Insight then modeled the future values of several key variables (such as GDP, disposable income, and the unemployment rate) that are inputs into FAA's aviation activity forecast model. We provided FAA with the results of Global Insight's model, and FAA used those results as inputs in its aviation activity forecast model and produced an alternative version of their aviation activity forecast. Holding all other factors in their model the same, FAA provided us with a forecast model for enplanements—the number of people boarding commercial aircraft—from 2014 to 2024. This forecast model takes into account the direct effect of fuel prices on enplanements through ticket prices as well as the indirect effects on enplanements through broader economic factors such as the level of real GDP, consumer disposable income, and the unemployment rate. Finally, we used FAA's forecast of aviation activity under higher fuel prices and its base case forecast to calculate and compare the trust fund receipts under each scenario over the next 10 years.

We conducted this performance audit from March 2013 to September 2014 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.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

Gerald L. Dillingham, Ph.D., (202) 512-2834 or dillinghamg@gao.gov

Staff Acknowledgments

In addition to the contact named above, the following individuals made important contributions to this report: John W. Shumann (Assistant Director); Amy Abramowitz; Namita Bhatia-Sabharwal; Kevin Egan; David Goldstein; and Bert Japikse.