THE HAMILTON PROJECT

Advancing Opportunity, Prosperity and Growth

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Dorothy Robyn
with support from
Kevin Neels

Air Support: Creating a Safer and More Reliable Air Traffic Control System

The Brookings Institution

The Hamilton Project seeks to advance America's promise of opportunity, prosperity, and growth. The Project's economic strategy reflects a judgment that long-term prosperity is best achieved by making economic growth broad-based, by enhancing individual economic security, and by embracing a role for effective government in making needed public investments. Our strategy—strikingly different from the theories driving economic policy in recent years—calls for fiscal discipline and for increased public investment in key growth-enhancing areas. The Project will put forward innovative policy ideas from leading economic thinkers throughout the United States—ideas based on experience and evidence, not ideology and doctrine—to introduce new, sometimes controversial, policy options into the national debate with the goal of improving our country's economic policy.

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NOTE: This discussion paper is a proposal from the author. As emphasized in The Hamilton Project's original strategy paper, the Project was designed in part to provide a forum for leading thinkers across the nation to put forward innovative and potentially important economic policy ideas that share the Project's broad goals of promoting economic growth, broad-based participation in growth, and economic security. The authors are invited to express their own ideas in discussion papers, whether or not the Project's staff or advisory council agrees with the specific proposals. This discussion paper is offered in that spirit.

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Abstract

Our nation's air traffic control system, run by the Department of Transportation's Federal Aviation Administration (FAA), has not kept up with the explosive growth in air travel. In 2007, flight delays cost passengers and airlines $12 billion to $14 billion in lost time and fuel. Flight delays are just a symptom of two fundamental problems with the way the federal government manages the air traffic control system. One problem is governance. As a traditional government agency constrained by federal budget rules and micromanaged by Congress, the FAA is poorly suited to run what amounts to a capital-intensive, high-tech service "business." Moreover, the FAA regulates as well as operates the air traffic control system, which represents a potential conflict of interest. A second problem is financing. The mechanism used to fund the system (passenger taxes, principally) encourages overuse of scarce capacity and deprives the FAA of feedback from its real customer: aircraft operators. Although the FAA plans to move to a next-generation, satellite-based system, the transition is currently scheduled to take nearly twenty years. Moreover, the severe and systemic problems that have plagued past FAA modernization efforts are almost certain to persist.

This paper argues for two major changes designed to improve the safety and reliability of the air traffic control system. The first would create a new modal administration within the Department of Transportation focused exclusively on delivery of air traffic control services and regulated at arm's length by the FAA. Most important, separation of the air traffic control operator from its FAA regulator would enhance safety by eliminating the potential conflict of interest that now exists. In addition, separation would help the air traffic control service provider clarify its mission, a key to improved performance, and make it easier to attract and retain outstanding senior leadership. The second change would replace excise taxes on passengers, cargo and fuel with cost-based charges on (most) aircraft operators themselves. Prices would give users an incentive to consume air traffic control resources efficiently and establish a direct link between users and the FAA ("user pay, user say"). I stop short of calling for moving the air traffic control system to a government corporation or some other (nonprofit) autonomous entity outside the traditional government bureaucracy. Although such a step would be highly beneficial, it does not appear to be politically feasible at this time.

Contents

1. Summary and Introduction

Aviation is a major catalyst for economic growth. Between 1978, when the U.S. airline industry was deregulated, and 2005, demand for scheduled air passenger service grew by an average of 4.5 percent a year, which is half again as much as the comparable increase (2.9 percent) in the U.S. economy overall (Federal Aviation Administration [FAA] 2007b).[1] In 2007, 769 million passengers boarded commercial airlines in the United States for business or leisure travel; that figure is expected to reach 1 billion by 2016 (FAA 2008b). The fast-growing air express sector, itself a product of deregulation, has been a boon to productivity, enabling services such as just-in-time delivery of industrial parts and e-commerce. Business aviation has also grown dramatically, and the use of private business jets, which now significantly outnumber commercial aircraft, is expected to double over the next decade with the introduction of very light jets and the growth of on-demand air taxi service (FAA 2008b). All told, civil aviation directly supports about $200 billion in economic activity and 1.1 million U.S. jobs (FAA 2007b).

Our nation's air traffic control system is an essential input to this vital sector of the economy. The air traffic control system is a network of radar, navigation aids, and about thirty-six thousand workers whose job it is to keep planes at a safe distance from one another and to guide them along an efficient flight path. The system is operated by the Federal Aviation Administration (FAA), an agency of the U.S. Department of Transportation (DOT). The FAA also regulates the safety of all aspects of civil aviation, including the operation of the air traffic control system itself.

The United States has the busiest airspace of any country: air traffic controllers safely orchestrate more than thirty thousand commercial flights a day—an impressive feat. However, the system has struggled to keep up with the increase in demand. The most visible symptom of the underlying problem is flight delays. In 2007, delays as measured by DOT cost U.S. airlines and passengers $12 billion to $14 billion in wasted fuel and time. The toll was far higher if one counts flight cancellations and the delays concealed by airlines' padded schedules. Moreover, the fuel burned during last year's flight delays generated 18 million tons of carbon dioxide—a nontrivial contribution to greenhouse gas emissions. The second symptom of the underlying problem is the FAA's reliance on antiquated technology. The limited precision of 1950s-era radar requires controllers to maintain wide safety buffers between aircraft, thus limiting airspace capacity. Pilots must zigzag between terrestrial navigation aids, consuming fuel and passengers' time. The third symptom is what it costs the air traffic control system to provide a unit of service, which has increased by 45 percent in the past decade.

If flight delays, antiquated technology, and rising unit costs are the symptoms, the underlying problem is the fundamental mismatch between the nature of air traffic control and the way the federal government manages it. To paraphrase James Carville, "It's the incentives, stupid." Two structural features of the system are largely to blame.

The first problem is governance. The provision of air traffic control services is not inherently governmental. Although it must be regulated for safety, air traffic control is a capital-intensive, technology-driven service business, albeit a monopoly. As a traditional government agency subject to federal budget restrictions and beholden to Congress, the FAA is not well suited to managing such an enterprise. The FAA has performed particularly poorly with respect to the development and adoption of

1. Demand for air travel is measured by revenue passenger miles.

new technology: its twenty-five-year, $50-billion "modernization" effort has been plagued by cost and schedule overruns and has yielded only incremental improvements in system capacity and safety. Although the FAA plans to move to a next-generation, satellite-based system (NextGen), the transition is currently scheduled to take nearly twenty years. Moreover, the systemic problems that have plagued past modernization efforts are almost certain to persist.

As a separate governance issue, the FAA's dual mission as both operator and regulator of the air traffic control system represents a potential conflict of interest. In every other area of aviation (e.g., the manufacture of aircraft and the operation of aircraft and airlines), the FAA has no operational role, acting instead as an independent regulator. Independent regulation is no less desirable in the case of air traffic control, where the fundamental issue of how much space to maintain between planes involves a trade-off between safety and airspace capacity. Although our system has an excellent safety record, the United States is one of the only industrial countries in which air traffic control is still operated and regulated by the same agency.

The second problem is the financing mechanism. The air traffic control system is supported largely by federal excise taxes on passenger tickets, cargo, and fuel. This system of tax funding imposes more of a burden on large than on small aircraft, even though it costs the system about the same amount to serve them ("a blip is a blip"). Current aviation taxes, together with airport landing fees based on aircraft weight, thus have the perverse effect of encouraging the use of smaller planes, which has become a major contributor to delays. Tax financing also deprives the FAA of valuable customer feedback: unlike a commercial firm that charges its customers, the FAA cannot compare its costs and revenues to learn how customers value its various services, where it needs to reduce costs, or where it should invest new capital.

To allow the air traffic control system to operate more like a business, the Clinton administration in 1995 proposed to transfer it to a nonprofit government corporation that would be supported by user charges and regulated at arm's length by the FAA. Although Congress rejected that approach, in 2000 (amid growing concerns about flight delays) it authorized the FAA to restructure air traffic control internally as a "performance-based organization" run by a chief operating officer (COO); President Clinton subsequently ordered that restructure. The resultant Air Traffic Organization (ATO), established in early 2004, has made progress toward becoming more customer oriented and businesslike, but severe constraints remain. And although it created a separate regulatory office to provide safety oversight of the ATO, the FAA still polices itself.

I argue in this paper for two major changes to improve the safety and reliability of the air traffic control system.

First, Congress should move the ATO out of the FAA and make it a separate modal administration within DOT, comparable to the Federal Highway Administration, the Federal Railroad Administration, and the FAA itself. The Air Navigation Services Administration (AirNav) would be led by a Senate-confirmed administrator who would report to the secretary of transportation. Ideally, a user-dominated board would advise the administrator on capital investments, cost control, and financing.

Most important, separation of the air traffic control operator from its FAA regulator would enhance safety by eliminating the potential conflict of interest that now exists. The key is transparency: if the FAA were an independent regulator, decisions now made internally would be made externally, allowing for greater outside scrutiny of proposed trade-offs between safety and capacity. Although safety experts have long called for this change, it is becoming even more critical as the air traffic control system shifts to satellite-based technology, which enables closer spacing of aircraft. Creation of AirNav would bring other important benefits by clarifying the respective missions of the air traffic control service provider and the FAA, and by making it easier for the service organization to attract and retain outstanding senior leadership.

Second, Congress should replace excise taxes on passengers, cargo, and fuel with cost-based charges on (most) aircraft operators themselves. Under my proposal, operators of commercial and turbine-powered business aircraft would pay a per-flight price roughly equal to the long-run marginal cost they impose on the system. To minimize transaction costs and reflect their lower demand on the system, operators of piston-engined aircraft, many of whom use separate and uncongested facilities, would continue to pay a fuel tax set at or close to the current level; alternatively, they could opt to pay a flat annual charge linked to aircraft size.

Reliance on cost-based pricing offers two major benefits. One, prices will provide valuable market signals, enhancing economic efficiency. If aircraft operators have to pay their way they will have an incentive to use scarce capacity more sparingly, thereby reducing delays. Moreover, the air traffic control operator will get the kind of feedback that price signals routinely provide, encouraging a more efficient production of services. For example, by using real prices, AirNav could offer and customers could purchase the services that best met their needs, as opposed to the current one-size-fits-all service. Two, reliance on user charges will reduce opportunities for congressional micromanagement because of the special budget treatment afforded to user fees. Customer involvement also will increase because users will be paying for the system directly ("user pay, user say").

In proposing the creation of AirNav, I stop short of calling for the transfer of the air traffic control system to a government corporation or other agency outside the traditional government bureaucracy. Since 1987, several dozen countries have adopted that model, restructuring their air traffic control provider as an autonomous, independently regulated agency with the freedom to adopt commercial business practices and to borrow money in the capital markets. The results in terms of safety and operating efficiency have been very positive. Although I believe the move to an autonomous air traffic control provider would be highly beneficial for the United States as well, it faces strong opposition from the air traffic controllers' union and from general aviation organizations. Among other things, opponents argue that such a change would degrade safety. This argument runs directly contrary to theory and experience, but it resonates with policymakers who fear that a "private" air traffic control provider (even one housed within a government corporation) would compromise safety.

Although my AirNav proposal may itself generate opposition, it should be easier to reach agreement on the core safety issue—the need to separate the air traffic control operator from its regulator—if, as I propose, the air traffic control operation were to remain inside the traditional government bureaucracy. Moreover, if AirNav were funded directly by cost-based charges on aircraft operators, in keeping with my second major recommendation, it would have many if not most of the advantages of an autonomous system.

To be sure, that second recommendation (pricing) is itself highly controversial. Although the Bush administration proposed to replace (most) taxes with cost-based user fees in its 2007 FAA reauthorization bill, the House rejected user fees altogether and the Senate was poised to reject them as well when its bill stalled over disagreements on other issues, including some issues of micromanagement of air traffic control.

But the debate over user fees was not dispositive. It was dominated by a "who should pay" fight between airlines (supporting user fees) and general aviation interests (opposing them). Members of Congress were understandably reluctant to take sides in a fight that appeared to turn largely on issues of equity. Moreover, the administration made revenue adequacy the focus of its campaign for user fees, arguing that they would provide a more stable revenue stream than excise taxes, and thus facilitate investment in NextGen. That argument fell short, however, because members concluded that they could address revenue needs merely by adjusting tax rates.

This debate ignored what I view as the most critical issue—namely, economic efficiency. As discussed above, the current system of tax financing creates flawed and even perverse incentives, contributing to delays and depriving the FAA of the direct customer input it desperately needs. Cost-based pricing would correct those incentives. The good news is that, because Congress is unlikely to reach agreement on an FAA bill this year, the next administration will have another opportunity to make what I believe is a compelling and ultimately winnable case for direct pricing of air traffic control.

2. Symptoms

The FAA has three distinct missions:

1. It is a regulator, overseeing the safety of all aspects of civil aviation and commercial space, including the design and maintenance of aircraft, the operation of aircraft and airlines, the licensing of pilots and flight instructors, and the operation of the air traffic control system.

2. It designs, equips, staffs, maintains, and operates the air traffic control system. This second mission (which I condense to "operation" of the air traffic control system) accounts for two-thirds of the FAA's total budget and about three-quarters of its total staff (FAA 2008c; FAA 2008d).

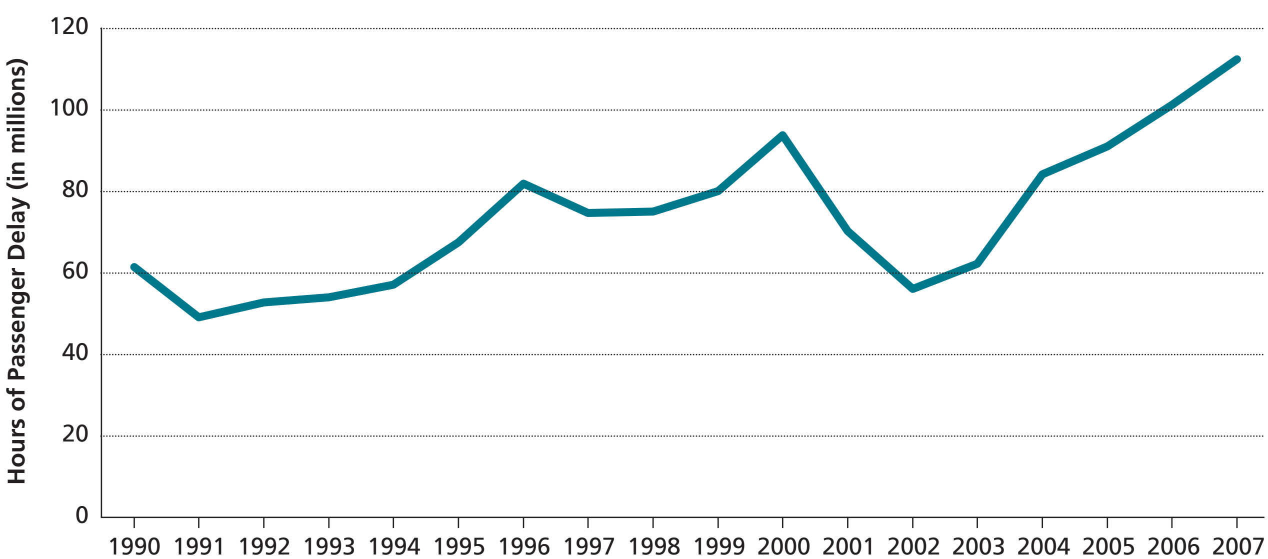
3. It provides grants to small and mid-sized airports through its Airport Improvement Program (AIP).

Although its budget has risen steadily, the air traffic control system has struggled to keep up with the sharp increase in air travel. Below, I look at three symptoms of the underlying problem: flight delays, antiquated technology, and the growing unit cost of service provision. I then discuss the causal problem itself—namely, the fundamental mismatch between the nature of air traffic control and the way the federal government manages it.

Flight Delays

Flight delays are the most visible symptom of the strain under which our air traffic control system is operating. During 2007, 24 percent of domestic flights were delayed, as defined by DOT (i.e., they arrived at least fifteen minutes beyond their scheduled arrival time) (U.S. DOT 2008a). The average delay for those flights was fifty-five minutes (FAA 2008e). In 2007, passengers lost more than 112 million hours due to delays, up from 100 million in 2006 (see Figure 1).

FIGURE 1
Hours of Passenger Delay, 1990–2007



Source: Compiled by GRA, Inc., based on ASQP and T100 Domestic Segment Data.

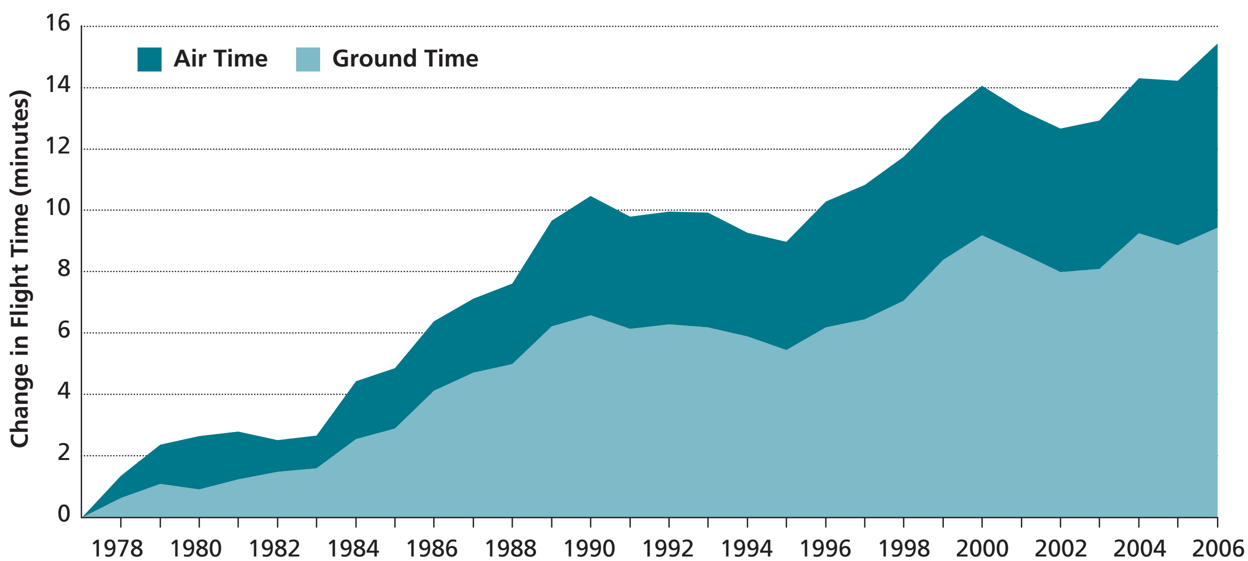
Flight delays are expensive. The Air Transport Association (ATA) estimates that the delays measured by DOT cost airlines about $8.1 billion in direct operating costs in 2007, largely in additional fuel consumption and increased expense for labor and aircraft maintenance (ATA 2008). Passengers pay the delay costs incurred by airlines indirectly in the form of higher fares. Passengers also pay for delays directly through the loss of their valuable time. Taking the passenger delay data from Figure 1 and using a low and high estimate of the value of passengers' time ($30 and $50 an hour), I estimate that last year's delays cost passengers $3.4 billion to $5.6 billion in lost time for a total direct cost to airlines and passengers of $11.5 billion to $13.7 billion.

Moreover, for several reasons these figures significantly understate the real cost of flight delays and congestion. First, DOT statistics on delays exclude flight cancellations and missed connections. Although relatively few flights are cancelled, a cancellation is far more disruptive to a traveler than a delayed flight. Research conducted at MIT and George Mason University suggests that cancellations account for 40–45 percent of actual passenger delays (see, for example, Calderón-Meza, Sherry, and Donohue 2008). Taking into account the impact of flight cancellations, passenger delays were up an estimated 29 percent in 2007 over 2006; they cost U.S. travelers $8.5 billion in lost time (Sherry and Donohue 2007).

Second, airlines have padded their published schedules to permit flights to arrive "on time" despite routine delays. Figure 2, compiled by Steven Morrison and Clifford Winston (2008) using data on all domestic flight segments from 1977 to 2006, shows that flight travel times have increased steadily due to both air and ground delays.

FIGURE 2

Change in Flight Travel Times, 1977–2006



Source: Morrison and Winston 2008.

The airlines' scheduled flight times on individual routes are also revealing. For example, according to Scott McCartney, the *Wall Street Journal's* aviation columnist, it now takes twenty-five minutes longer to fly from New York to Los Angeles than it did ten years ago. Flights from New York to Washington, DC, which involve only about thirty-five minutes in the air, are now routinely scheduled for well over an hour ("The Middle Seat: Why Flights Are Getting Longer," May 29, 2007).

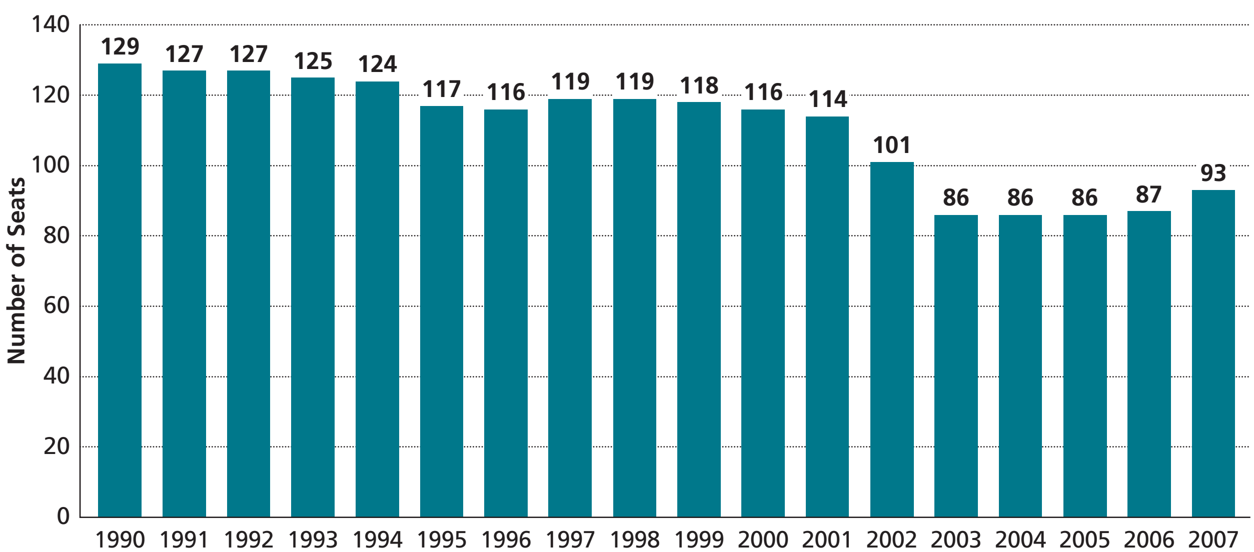
Third, even the most expansive measure of the costs of congestion to passengers and airlines ignores the considerable harm to the environment. Most significant, aircraft burn additional fuel when flight delays force them to wait on the ground to take off or circle above an airport waiting to land, and that generates carbon dioxide. Based on the ATA's (2008) estimate of the amount of fuel burned in 2007 as a result of flight delays (1.8 billion gallons), I calculate that delays caused the release of 18.7 million tons of carbon dioxide into the atmosphere.[2] This is equivalent to the annual carbon emissions of about 2.5 million automobiles.[3]

A proximate cause of the increase in air traffic congestion and delays is the dramatic decline in average aircraft size. From 1990 to 2007, the average number of seats per domestic departure dropped from 129 to 93 (see Figure 3). As airlines have gone to smaller aircraft, the number of flights they operate has grown faster than the number of passengers they carry.

This trend largely reflects the expanded use of regional jets (RJs), which flew about 34 percent of all commercial flights in 2007 (Innovata 2008). RJs are popular because they allow airlines to use lower-cost pilots and offer the more frequent service that attracts high-revenue business passengers ("frequency sells"). The growth of RJs has been especially pronounced at some of the largest and most delay-plagued airports (see Figure 4). For example, from August 2002 to August 2007 New York's LaGuardia airport experienced a 49 percent jump in scheduled flights of aircraft with fewer than a hundred seats and an 8 percent decline in flights using aircraft with more than one hundred seats (Hughes 2007).

FIGURE 3

Average Number of Seats per Departure, 1990–2007

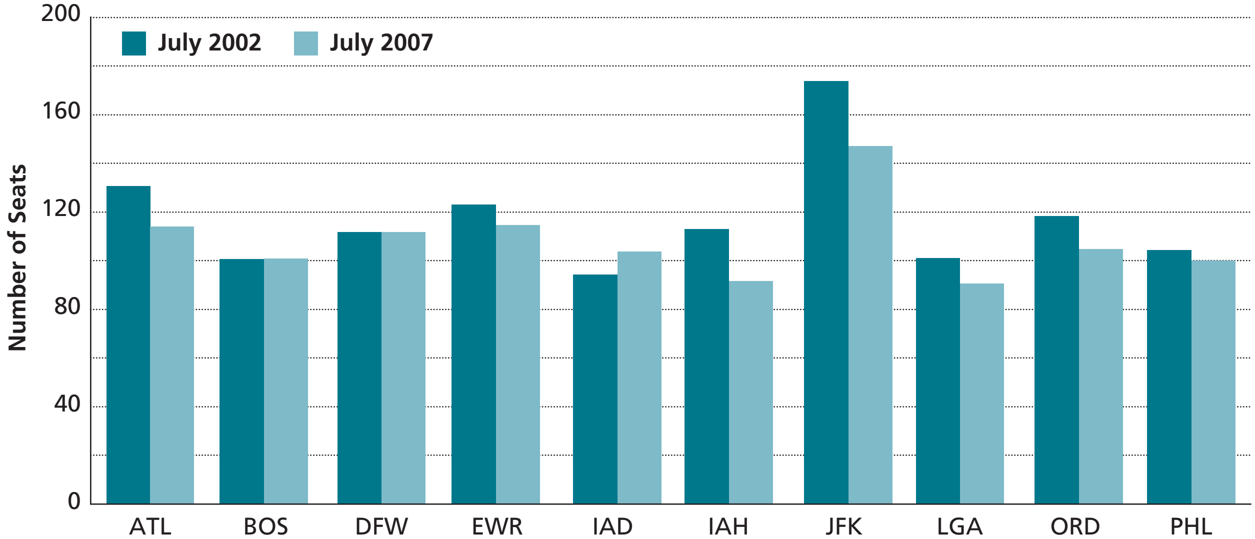


Source: T100 Data.

2. ATA reports the cost of fuel burned due to delays ($3.727B). The average price of fuel for 2007 was $2.10 (U.S. DOT 2008b, Form 41 Financial Data).
3. This figure assumes than an automobile will be driven twelve thousand miles a year on average, with a fuel efficiency of sixteen miles to the gallon.

FIGURE 4

Average Number of Seats per Aircraft by Airport, 2002 vs. 2007 (all departures)



Source: Compiled by GRA, Inc., based on OAG Data.

In recent months, this trend has begun to turn around in response to the dramatic rise in fuel costs and the softening economy. In addition to replacing fifty-seat RJs with larger aircraft, airlines are eliminating a substantial number of now-unprofitable flights. Many industry experts predict that flight delays will be gone by next year if fuel prices stay at (or go above) current levels.

If this happens, it will not be the first time. U.S. airlines experienced serious air traffic control delays in the late 1960s causing the FAA to impose slot controls at the major airports in New York, Chicago, and Washington, DC—controls that are still in place. Prolonged delays returned in the late 1980s, and again in 1999 and 2000. In each case, a downturn in the economy eventually eliminated the problem, albeit temporarily.

Antiquated Technology

Flight delays in part reflect the FAA's continued reliance on fifty-year-old technology. Controllers use 1950s-era, ground-based radar to route planes, and pilots and controllers communicate using analog, voice-only radios (i.e., no e-mail or instant messaging). As reported by Randall Lane in *Forbes* (1996), well into the 1990s, the FAA was the largest U.S. buyer of vacuum tubes. The vacuum tubes, which were used in the FAA's decades-old radar and communications systems, had to be purchased from other countries because they were no longer produced in the United States (Clinton 1995). In many facilities, controllers still keep track of aircraft using paper strips. This antiquated and inefficient technology represents a second symptom of the problem with our air traffic control system.

Outdated technology seriously limits the capacity of the system, contributing to delays. In addition, it imposes nondelay costs on airlines, passengers, and the environment. The limited precision of the FAA's aging radar requires controllers to maintain wide safety buffers between aircraft, which is a key constraint on airway and runway capacity. Planes must zigzag between terrestrial navigation aids rather than fly the most direct routes, consuming fuel and passenger time. Finally, aging equipment requires a high level of costly maintenance.

Antiquated technology is a reflection of the FAA's chronically poor performance when it comes to the development and adoption of new technology. In their book on air traffic service provision in the United States and other countries (*Managing the Skies: Public Policy, Organization and Financing of Air Traffic Management*), Clinton Oster and John Strong observe that "most FAA modernization projects have a record of (1) promising more capability than they ultimately deliver, (2) being completed later than promised, and (3) costing far more by the time they are completed than the initial cost estimates" (Oster and Strong 2007, 146–47).

When the FAA undertook air traffic control modernization in 1981, it estimated the work would cost $12 billion and take a decade to complete. Twenty-seven years and $50 billion later, the FAA still has not been able to achieve large-scale modernization. Most of that money has gone to replace and upgrade existing equipment, yielding only incremental improvements in capacity and safety (National Civil Aviation Review Commission 1997).

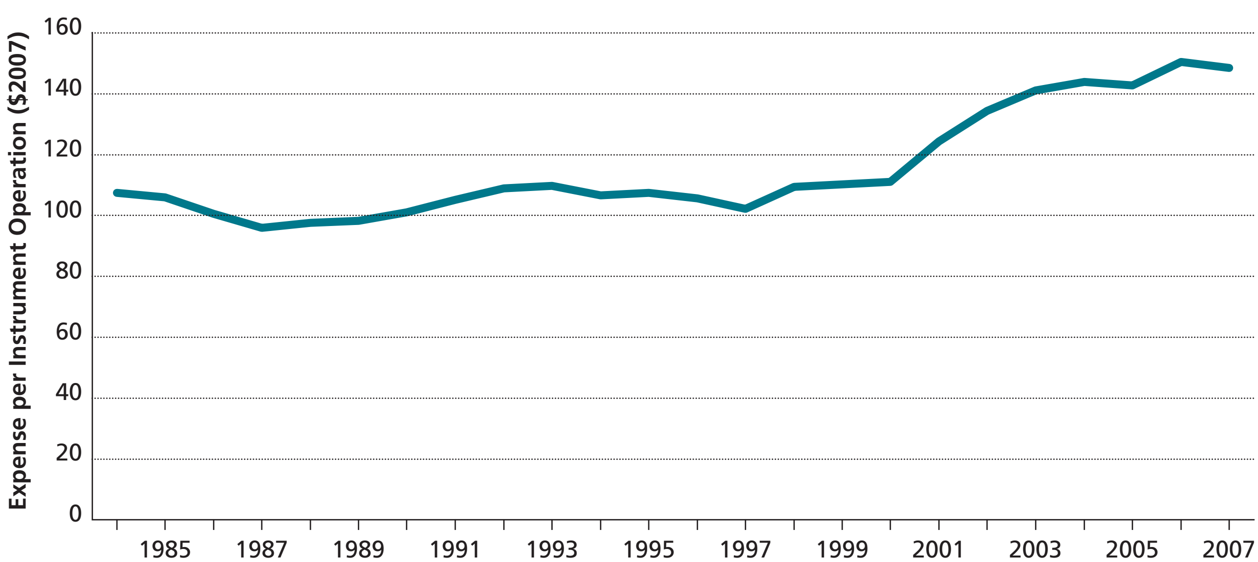
Growing Unit Cost of Service Provision

Despite the FAA's $50 billion investment in modernization, the cost of providing air traffic control services is significantly higher now than it was when the agency began that effort. This increase in operating costs represents a third symptom of the deeper problem that plagues the air traffic control system.

Figure 5 shows the change in the unit cost of air traffic control service provision over time as measured by the FAA's cost-per-instrument-operation, adjusted for inflation. The FAA's unit cost was flat from 1984 to 1997. This is in contrast with the trend in most high-tech activities, which benefited from the plummeting cost of computing power. Moreover, in the past ten years FAA unit costs have gone up by 45 percent, largely because of wage increases in the collective bargaining agreement that the FAA signed with the National Air Traffic Controllers Association in 1998. Although the agreement envisioned that productivity gains would offset the

FIGURE 5

Air Traffic Control Unit Cost, 1982–2007



Source: Data on number of operations through 1989 are from FAA Air Traffic Activity, FY 1994 FAA APO-95-11. Data on number of operations from 1990 onward are from the Air Traffic Activity System. Operating expense data are from various editions of the *FAA Administrator's Factbook*.

wage increase, those gains have not materialized.

Controllers argue that an increase in unit cost is natural because the provision of air traffic control services is labor intensive. I disagree: air traffic control is not inherently labor intensive. On the contrary, the air traffic control system, which amounts to a large telecommunications network, is capital intensive, and telecom costs elsewhere have dropped significantly, thanks in part to Moore's Law. Although new technology will not eliminate the need for controllers, many of the routine tasks that they now perform could be performed more efficiently—and more safely—by new hardware and software. For example, a large fraction of all air-to-ground communications involves the hand-off of a flight from one sector to another, a task that could and should be automated, allowing controllers to focus on more complex and challenging tasks.

3. The Problem

If flight delays, antiquated technology, and rising unit costs are the symptoms, the underlying problem is the mismatch between the nature of air traffic control and the way the federal government manages it. Two key features of the system, governance and financing, create flawed incentives, leading predictably to massive inefficiencies and posing a potential safety concern.

Governance

The first problematic feature of our air traffic control system is its governance structure. Stated simply, air traffic control is a $9 billion-a-year, high-tech service business operating out of a command-and-control government agency that is constrained by federal budget rules and micromanaged by Congress.

"Ferrari Engine in a Dump Truck Body"

The air traffic control system operates twenty-four hours a day, 365 days a year. An entire industry depends on it for its every move. Although the provision of air traffic control services must be overseen by a government safety regulator, it is not itself an inherently governmental function. Instead, it has the essential characteristics of a business.

- Air traffic control activities are purely operational. That is, those activities involve the delivery of a routine service through the equivalent of a production line.
- Because air traffic control is purely operational, the mission of an air traffic control service provider is clear and its performance is measurable.
- The direct users of the air traffic control system (airlines and private aircraft operators) are identifiable, and most of the benefits and costs of the services accrue to those already paying the costs via user taxes (passengers, shippers, and aircraft owners).

Perhaps the strongest evidence that air traffic control is not inherently governmental comes from the several dozen countries where air traffic control services are now provided by a self-supporting autonomous agency outside the traditional government bureaucracy.[4]

The governance problem arises because, as a traditional government agency, the FAA is not suited to operating what amounts to a business. David Osborne, who popularized the phrase "reinventing government," sums up this fundamental mismatch in a book he co-authored with Peter Plastrik: "The FAA's problems have been studied repeatedly for at least 15 years; indeed, the FAA has been 'commissioned' to death. There is significant consensus about the basic problem: air traffic control is a massive, complex, technology-intensive service business operating within a conventional U.S. government bureaucracy…. It is a bit like putting a Ferrari engine into a dump truck body and still expecting it to win races" (Osborne and Plastrik 2000, 106).

Most important, FAA management faces the wrong incentives. Whereas ordinary businesses must respond to customers to survive, the FAA faces incentives that are more complex.

Just as a green plant turns toward the sun, organizations tend to pay close attention to the sources of funding that sustain them. The FAA is no exception. Because it relies on appropriated funds, the FAA has historically viewed Congress rather than aircraft operators as its customer. One former senior FAA official observed that, when funding was

4. These countries include Australia, Austria, Canada, Czech Republic, Germany, Ireland, Italy, Latvia, the Netherlands, New Zealand, Portugal, Russia, South Africa, Switzerland, Ukraine, and the United Kingdom.

tight, the agency reduced services in the field and expanded headquarters staff. This is the opposite of what an airline or other service business would do; such a response is "rational" if the customer is Congress, however.

Because Congress holds the purse strings, FAA decisions regarding facilities, investment, maintenance, staffing, and pay are all subject to interference. Members of Congress opposed to the loss of jobs in their districts have long blocked large-scale consolidation of the FAA's aging and inefficient facilities, a much-needed step that would save the system hundreds of millions of dollars a year (Harrison, 2005).[5] Even minor proposed changes, such as a recent plan to close FAA operations at several dozen lightly used airports in New York and New Jersey from midnight to 5:00 a.m. routinely meet a similar fate.

Congress micromanages FAA spending on investment and maintenance as well. Appropriators routinely give the agency less money than it requests for some programs and more for others, based in part on lobbying by private contractors. Moreover, logrolling can lead to a largely rural state receiving the same technology as, say, New York, despite major differences in demand (GAO 2005b, 17–18). It is not uncommon for a member of Congress to direct the FAA to build a multimillion dollar tower or install an instrument landing system at an airport in his or her district, typically to promote economic development. In addition to bearing the initial expense (an investment that necessarily fails the agency's cost/benefit test, or it would not have required outside intervention), the FAA must then pay to maintain the tower or instrument landing system indefinitely.

Congressional micromanagement of the air traffic control system is doubly harmful because it crowds out much-needed input from airlines and other aircraft operators, who are the system's real customers. According to an expert panel convened by the National Academy of Sciences (NAS) to assist the GAO in understanding the impediments to FAA modernization, because the ATO is beholden to Congress, "the users lack incentives to monitor the ATO's spending and may not insist on cost control, while the ATO lacks incentives to consult the users and may invest in technologies that the users do not want" (GAO 2005b, 29).

Federal budget rules create their own, perverse incentives. As with other government agencies dealing with large infrastructure projects, FAA managers face strong pressures to overestimate the benefits, underestimate the costs, and downplay the risks in order to sell the projects to decision makers (Hansen 2007). Because capital investments must be funded out of annual appropriations, major acquisitions take years to carry out and the technology may be out of date by the time it is deployed. Budget shortfalls and delays in the appropriations process further slow capital projects and drive up their costs.

The FAA's chronic miscalculation of costs and risks also reflects the lack of in-house engineering expertise, which is itself a result of budget constraints and federal salary caps. The NAS panel identified the lack of technical expertise needed to design, develop, and manage complex air traffic systems as one of two key factors that has impeded modernization (GAO 2005b, 6, 12–13). Lacking in-house experts, the FAA must rely heavily on outside contractors, even the best of whom have a somewhat different objective than the FAA. As a result, when it comes to modernization the agency is missing what one NAS panel member called a "rudder" (GAO, 13).

The other key impediment to modernization iden-

5. The air traffic control system has twenty-one en route centers and one hundred fifty terminal radar approach control facilities. In theory, technology makes it possible for the FAA to manage the entire system from a single, giant facility. In practice, it makes sense to have redundant facilities, but the appropriate number is far fewer than what we now have. For fear of Congress' response, the FAA has not made a detailed proposal for large-scale consolidation in many years, although in 2007 the Bush Administration did ask Congress to authorize an up-or-down-vote process similar to that used to get congressional agreement on military base closures. Congress has not acted on that request.

tified by the NAS expert panel was "cultural." Specifically, it was a "resistance to change . . . [that is] characteristic of FAA personnel at all levels" (GAO 2005b, 6). The National Air Traffic Controllers Association has opposed new technologies that controllers fear would threaten their jobs, and many FAA managers, insulated from the economic pressures that their counterparts in industry face, have resisted the shift to a performance-based ATO.

This cultural resistance to change reflects the FAA's traditionally rigid hierarchy, which diffuses responsibility and weakens accountability. In an unusually perceptive report on the FAA's culture, the GAO concluded "the agency's hierarchical structure has fostered a controlling environment in which employees do not feel empowered to make decisions or are not held accountable for the decisions they do make" (GAO 1996, 6). Despite the chronic cost and schedule overruns on one modernization project after another, to my knowledge no FAA program manager was ever fired as a result of poor project performance.

Potential Conflict of Interest

As a separate governance issue, the FAA's dual mission as both operator and regulator of the air traffic control system represents a potential conflict of interest. Such an arrangement is generally inferior to one in which an arm's length regulator provides independent oversight, because the latter requires that trade-offs between competing goals be made explicitly and transparently. For example, in 1974 Congress replaced the dual-hatted Atomic Energy Commission with two independent entities, the Department of Energy and the Nuclear Regulatory Commission, to provide for arm's length regulation of nuclear safety.[6]

Arm's length regulation is no less desirable in the case of air traffic control, where the fundamental issue of how much space to maintain between planes involves a trade-off between safety and airspace capacity. Oster and Strong (2007) explain: "FAA has two goals in operating the air traffic control system, and these goals can often pull in different directions. One goal is to operate the air traffic control system safely. The other is to provide enough capacity to avoid excessive and persistent delays. Some of the potential ways of improving safety can reduce capacity and increase delays, and some potential ways of increasing capacity can reduce safety. Currently, FAA, as both regulator and operator of the air traffic control system, makes the capacity versus safety trade-offs internally" (152–53).

Oster and Strong (2007) contrast this with other aspects of U.S. aviation overseen by the FAA, including the design and manufacture of aircraft and aircraft components, aircraft maintenance, airline operations, and the training and certification of pilots and mechanics. Because the FAA has no operational responsibilities in these areas, it provides independent regulatory oversight.

Governments worldwide recognize the value of independent regulatory oversight of air traffic control. The International Civil Aviation Organization, a United Nations agency whose principles are the basis for aviation safety regulation throughout the world, calls for the air traffic control safety regulator to be separate from the operation it regulates (International Civil Aviation Organization 2006).[7] Dozens of countries have opted to separate the two functions as part of their efforts to reorganize air traffic control along more commercial lines. The United States is one of the only industrial countries in which the same agency continues to both operate

6. As another example, the National Transportation Safety Board, an independent regulatory agency, was initially housed physically in the DOT. The Board subsequently relocated its offices and severed other ties with DOT because of concerns about its independence.
7. "In those States where the State is both the regulatory authority and an air traffic service provider, . . . the requirements of the Convention [on International Civil Aviation] will be met, and the public interest be best served, by a clear separation of authority and responsibility between the State operating agency and the State regulatory authority" (¶2.4.9); and "When a State has found it necessary to separate service provision functions by the creation of commercial entities outside of the [civil aviation authority], . . . a clear division of responsibilities shall be defined between the regulatory functions and service provision functions. Regulatory and safety functions shall remain the responsibility of the State" (¶3.2.6).

and regulate the air traffic control system (Oster and Strong 2007).

In response to concerns about lack of independent oversight, in 2005, following the formation of the ATO, the FAA created a separate office to regulate the safety of air traffic control. The FAA regulatory office, however, which has a staff of only about twenty, is dwarfed by the ATO's own safety office. Moreover, both offices ultimately report to the FAA administrator. In short, the internal restructuring has created greater separation between the regulation and the operation of the air traffic control system, but the FAA still polices itself.

Although safety experts have long recommended it, independent regulatory oversight of the air traffic control operator is becoming even more important as we transition to the next generation of air traffic control technology. According to a recent joint statement by nine leading aviation experts, "as the ATO moves forward to implement the dramatic changes in technology and procedures inherent in the NextGen concept . . . [m]any decisions about increasing capacity by reducing aircraft spacing (thanks to new technologies and procedures) have important safety implications, and should be arrived at in a transparent manner. Arm's length separation cannot be accomplished as long as ATO operations and aviation safety regulation reside in the same governmental unit" (Reason Foundation 2007, 2).

Financing

The second structural problem with the air traffic control system is the way it is financed. Although any funding mechanism that encourages congressional micromanagement will lead to the kind of governance problems discussed above, the existing mechanism is particularly problematic because of the flawed financial incentives it creates for users (aircraft operators) and the FAA.

To elaborate, the air traffic control system is supported largely by federal excise taxes. Most of the tax revenue comes from an ad valorem ticket tax and a flat charge per flight segment, both paid by airline passengers. Domestic air cargo shippers pay an ad valorem tax on the price of shipments. Most business aviation and general aviation users pay a fuel tax; the exceptions are operators of air taxis and fractional jets, who pay a ticket tax.[8] See Table 1.

TABLE 1

Current Aviation Excise Taxes, 2007

Aviation tax	Rate (2007)
Domestic passenger ticket tax	7.5 percent of ticket price
Domestic flight segment fee	$3.40 per segment
International arrival & departure tax	$15.10
Flights between continental U.S. and Alaska or Hawaii	$7.50 + applicable domestic tax rate
Frequent flyer tax	7.5 percent on mileage awards
Domestic cargo/mail	6.25 percent of amount paid for the transportation of property by air
General aviation fuel	Avgas: $0.193/gallon
	Jet fuel: $0.218/gallon
Commercial fuel tax	$0.043/gallon

8. Fractional jets are private aircraft whose owners buy a share (fraction) of a plane rather than an entire plane. Fractional ownership is the aircraft equivalent of a condominium timeshare.

Ideally, the financing mechanism for such a critical piece of infrastructure should achieve three goals (Congressional Budget Office 1992). First, it should encourage efficient behavior on the part of both users and the service provider (economic efficiency). Second, it should recover most or all of the revenue needed to support the continued operation and expansion of the system (revenue adequacy). Third, it should be equitable. The existing financing mechanism fails on all three counts.

The inequity of the present tax-based financing system has been well documented. According to FAA analysis, general aviation users are responsible for approximately 16 percent of system costs yet they provide only 3 percent of system revenues (FAA 2007c). In contrast, commercial carriers account for roughly 74 percent of system costs, yet they supply approximately 97 percent of system revenues (FAA 2007c).[9] Moreover, within general aviation roughly two-thirds of costs, or about 10 percent of overall system costs, are associated with turbine-powered business aircraft (FAA 2007a). These aircraft have performance characteristics similar to those of commercial aircraft, and they place similar demands on the system (i.e., they fly in the same airspace as commercial jets), but on a per-usage basis they contribute only a fraction of the revenues. The U.S. airline industry made this disparity the focus of its recent, high-profile campaign to replace excise taxes with user fees.

The failings of the current mechanism with respect to revenue adequacy have also been well documented. In fact, they were the major justification for the Bush administration's proposal to shift to user fees, which was the centerpiece of its 2007 FAA reauthorization bill. The key problem here is the disconnect between what drives costs to the air traffic control system (primarily the number of aircraft movements), and what drives system revenues (primarily the number of passengers and the price of their tickets).[10] With the downward trend in aircraft size (more flights, each carrying fewer passengers), growth in aviation tax revenues has tended to lag growth in system costs, a tendency that the long-term decline in real airline fares since deregulation has only amplified. Moreover, the gap between costs and revenues can be expected to grow as high-performance business aircraft continue to proliferate. Citing these troubling trends, the administration argued that the lack of a stable revenue stream would impede FAA investment in the NextGen air traffic control system (see, for example, FAA 2007c and 2008a).

Economic Efficiency: The Overlooked Policy Goal

In addition to its shortcomings in terms of equity and revenue adequacy, the current system of excise-tax financing creates flawed and even perverse incentives that undermine economic efficiency. Users do not confront the costs they impose on the system, which leads them to schedule more flights on smaller planes than they otherwise would. Moreover, the FAA is deprived of the kind of customer input that normally drives decisions on production and investment. In these ways, tax financing contributes directly to the problems that plague the air traffic control system.

To elaborate, the current system of tax financing encourages commercial airlines to overuse scarce air traffic control capacity in part because they pay for that capacity indirectly through passenger taxes rather than directly for each use. Moreover, because the taxes collected are linked to the number of passengers (and the price of their tickets) a small aircraft contributes significantly less than a large one, even though it costs the air traffic control system about the same amount to serve ("a blip is a blip"). For example, a one hundred forty-seat Airbus A320 flying from Denver to Phoenix contributes about $1,400 in taxes, whereas a seventy-seat RJ on the same route pays less than half that (about $650).[11]

9. These figures include air taxis and fractional jets. For scheduled commercial passenger and cargo carriers alone, the comparable figures are 68 percent and 94 percent (personal communication with David Lee, ATA, June 2008).
10. For an excellent analysis of this issue, see Oster and Strong (2007), 131–46.
11. Personal communication with David Lee, ATA, July 2008.

Consider the incentives this situation creates for an airline. By substituting two RJs for one large jet the airline can offer flights that are more frequent. This is a major draw for high-yield business passengers. Although that substitution doubles the FAA's workload, the airline and its passengers pay roughly the same in total taxes.

In short, because they impose a disproportionate burden on large aircraft, passenger taxes have the perverse effect of encouraging airlines to use smaller planes. Moreover, airport runway landing fees, which are based solely on aircraft weight, serve to reinforce that effect (Levine 1969).[12] These implicit subsidies to small aircraft are one reason (albeit only one) that the use of RJs has expanded so rapidly, and with them delays. Airlines are providing what customers want, which is more frequency, but the perverse way we charge for airways and runways allows them to reap the benefits without having to pay the true costs.

Turbine-powered business aircraft, which pay a fuel tax, contribute even less relative to the burden they impose, as noted earlier. In addition to being inequitable, this creates another market-distorting subsidy to small aircraft. A six-passenger Gulfstream 450 corporate jet flying from Denver to Phoenix pays only $133 in taxes, even though it uses the same airspace and requires the same attention from controllers as the commercial A320 paying $1,400.[13] And while business jets typically avoid the most crowded large-hub airports, the rapid expansion of traffic to neighboring reliever airports such as Teterboro, near the Newark airport, has added to congestion in the terminal airspace.

Tax financing creates the wrong incentives for the FAA as well because, under the present system, the connection between the volume and mix of air traffic control services provided and the revenues received by the air traffic control system is tenuous. Unlike a commercial provider that charges its customers for what they consume, the FAA cannot compare its costs and revenues to learn how customers value its various services, where it needs to reduce costs, which services to develop or improve, or where to invest new capital.

There may well be significant latent demand by users of the system for location-specific improvements in service quality, quantity, or reliability. The widely used hub-and-spoke system makes individual carriers highly dependent on the smooth and reliable operation of hub airports. Might they be willing to pay a premium to ensure a higher degree of reliability at these critical network locations? Under the current system, the FAA has no incentive to provide location-specific value-added services because it cannot charge users for them.

The present financing system also fails to relate appropriately costs and revenues over time. Under current budget rules, capital expenditures by the tax-funded ATO are expensed against current receipts: they are on budget. As a result, current users pay for capital investments that will benefit future users, a source of intertemporal inequity. Moreover, given the tight constraints that the federal budget has faced, R&D and long-term investments can easily be shortchanged.

In sum, the flawed and perverse incentives created by the current system of excise-tax funding contribute directly to the problems that plague the air traffic control system, including delays and the system's lack of customer orientation. In my view, this is the most critical shortcoming of the current funding mechanism, yet virtually no one mentioned "economic incentives" in the recent prolonged debate over how best to finance the air traffic control system.[14] Remarkably, despite the backdrop of record

12. Commendably, the Bush administration has sought to clarify federal policy to allow airports to replace or supplement weight-based landing fees with market-based prices, including congestion pricing of runways and the auction of scarce runway slots. But the airline industry opposes any policy change that would facilitate congestion pricing.
13 Personal communication with David Lee, ATA, July 2008.
14. For a notable exception, see Orszag (2007).

flight delays, the debate included no discussion of how the current funding system encourages overuse of the system. Economic efficiency or the lack thereof was the overlooked issue.

Recent Developments

ATO: Visible Improvement, but Not Enough

In 1995, amid growing frustration over the FAA's inability to modernize, the Clinton administration proposed to spin off the air traffic control operation to a government corporation, U.S. Air Traffic Services, Inc. The proposal called for that corporation to be run by a chief executive officer reporting to a board of directors, to be financed by cost-based fees on commercial users, and to be regulated at arm's length by the FAA. Although Congress flatly rejected the "corporatization" of air traffic control, in 2000, as flight delays reached record levels, it authorized the FAA to restructure air traffic control internally as a semiautonomous "performance-based organization" run by a chief operating officer (COO); President Clinton subsequently ordered that restructure. Following a three-year search, the FAA named Russell Chew, the highly respected head of American Airlines system operations, as COO. In early 2004, the FAA formally established the ATO.

Chew encountered a management culture that he described as "intensely hierarchical [and] risk averse" (GAO 2005b, 15) and a lot of hard-working, dedicated employees "who don't know . . . what their mission is" (Ciurczak 2003, 5). He saw his job as bringing businesslike practices and a performance culture to a government organization that is in the service business. Toward that end, he sought to motivate ATO employees around the goal of customer service and to push cost control and accountability down to managers at the lowest level.

Chew made considerable progress in putting the basic building blocks in place.[15] Nevertheless, he left well before the end of his five-year term, after just three and a half years. He made little secret of his frustration over the lack of autonomy he enjoyed with respect to senior FAA appointees and Congress.

According to the NAS expert panel, "the ATO's organizational placement, combined with its dependence on Congress for funding, limits the COO's ability to make decisions and take actions" (GAO 2005b, 31). One panelist indicated "the COO is not a Chief Executive Officer. . . . Instead, he reports to his 'owners'—who include the FAA Administrator and the DOT Secretary . . . and Congress" (GAO 2005b, 31). Because the ATO is embedded so deeply in the executive branch, the panel observed, the COO has no way of communicating directly with the relevant congressional committees.

NextGen

The FAA's answer to the problem of flight delays is the NextGen air transportation system, designed to replace ground-based radar and navigation aids with satellites and cockpit controls.[16] NextGen is a collection of ongoing and new programs intended to triple capacity by 2025 at a cost to the government of $20 billion to $25 billion, not including the cost of continuing to maintain and modernize the existing system. The details of how NextGen will work are the focus of a planning effort overseen by the interagency Joint Planning and Development Office and supervised by a senior policy committee chaired by the secretary of transportation.

The FAA has taken several market-oriented steps in the context of NextGen, including a 2007 contract for Automatic Dependent Surveillance–Broadcast (ADS-B), a backbone technology that will allow pilots to broadcast their position and "see" nearby traffic in real time. The contractor will develop, in-

15. Among other things, Chew recruited a senior vice president for finance who had extensive industry experience; implemented the long-delayed cost-accounting system, allowing the ATO to measure its costs and compare costs and productivity across facilities and over time; integrated the two main organizational units (operations and acquisition) so that investments would better serve operating goals; established detailed performance metrics; and created a top-notch office of strategy and performance evaluation.

16. See Robyn (2007, 25–37) for a more detailed discussion of the next-generation air transportation system.

stall, and operate the ADS-B ground infrastructure, and the FAA will merely lease the service. This arrangement is in principle efficient because it internalizes the costs and benefits: the contractor has an incentive to build and install the equipment properly because it will also own and operate it.

Despite these and other positive steps, the federal government's approach to NextGen raises real concerns. First, it is a highly ambitious program geared to transformation of the current system. A Boeing air traffic control expert views NextGen as comparable to NASA's International Space Station or the U.S. Army's Future Combat System in terms of complexity and implementation challenges (Lewis 2007). Given its poor track record on modernization, one has to question whether the FAA is capable of carrying out such an ambitious makeover.

Second, part of what makes NextGen so risky is that its success depends on aircraft operators making expensive investments in advanced avionics. It is a chicken and egg problem: until there is near universal equipage by users (the egg), the ATO's investment in new infrastructure (the chicken) will be only partially effective. In addition, the FAA must change its operating procedures to exploit the new technology.

This three-part harmony would be difficult to achieve under any circumstances, but it is especially challenging here. The lengthy transition to NextGen (nearly two decades) was designed to ease the financial burden of equipage on aircraft operators, but it delays the realization of benefits for many years. Moreover, aircraft operators are skeptical of FAA promises to deploy the complementary infrastructure because of the agency's history of embracing a new technology aggressively, urging the airlines to invest in it, and then dropping the development program for financial or other reasons.[17] The length of the NextGen transition only adds to the skepticism.

Airlines are also skeptical of FAA claims of how much NextGen will increase the productivity and reduce the costs of the system. And, in fact, the FAA has already backed off its estimates of what ADS-B could save by allowing the agency to turn off expensive radars—estimates that drove its own business case for ADS-B. The agency now says that it will have to maintain many of the radars indefinitely to protect safety and homeland security.

Third, the NextGen planning process consists largely of government scientists and engineers charged with figuring out what system users will need twenty years from now. Even commercial firms pick the wrong technology when they make such long-term investments: recall Motorola's $8 billion bet on Iridium satellite phones, which failed to anticipate the emergence of cheaper, lighter, and ubiquitous cell phones. What are the odds that the Joint Planning and Development Office, a hierarchical planning process buffeted by political winds, will get its bets right? One problem is that the group's technology-centric outlook largely ignores how the market itself may change. There is an implicit assumption that air traffic control will remain a monopoly. Yet other network industries such as telecommunications have proven to be more amenable to the introduction of competition than was once thought possible, largely because of technological change.

NextGen represents an immense coordination problem, one that involves aircraft operators of all types, airports, and manufacturers, as well as the FAA and other federal agencies. The design of such a system needs to reflect customers' willingness to

17. For example, in the late 1980s, the FAA embraced the microwave landing system; because it took the agency so long to approve it, the approach was overtaken by GPS technology. More recently, several U.S. airlines invested in Future Air Navigation System equipment to allow for more efficient trans-Pacific operations, based on FAA assurances that it would deploy compatible equipment. However, the FAA failed to make good on those assurances largely because of resistance from a major carrier. Nor does the FAA have a good track record when it comes to changing its operating procedures to exploit new technology. Some equipment manufacturers see this as the major impediment to NextGen.

pay, the incremental costs of capacity, and a host of other factors that cannot be determined through a hierarchical, politicized process.[18] Although there is a role for a central planning authority, NextGen planning requires the feedback at every turn that only market signals provide.

Finally, NextGen, like modernization, is being oversold. Members of Congress are told that new technology will eliminate delays, relieving them of the need to address underlying structural problems, problems that have consistently impeded the FAA's ability to adopt new technology in the first place.

In short, the federal government's overly ambitious, technocentric, one-size-fits-all approach to NextGen seems to embody much of what is wrong with the current air traffic control system. Unless there is some fundamental reform of the governance and financing problems discussed above, it seems likely that NextGen will go down the same troubled path as modernization. As Matthew L. Wald points out in an article in the *New York Times* ("A Long List of Big Issues for the FAA," May 8, 2008), one former secretary of transportation likens the current discussions of NextGen to the movie *Groundhog Day*, in which the main character finds himself in a seemingly endless time loop, forced to relive the same bad day again and again.

18. As one example, the goal of tripling capacity, which drives much of NextGen's cost, reflects political as well as market forces. According to one expert, this goal is in part a response to the prospect of on-demand, small jet services, and the desire of many in industry to see this phenomenon play out in the market without regard to infrastructure limitations (Hansen 2007). The question for policymakers is whether (future) users would want that level of expansion if they had to pay for it.

4. Proposed Reforms

I argue below for two major changes designed to improve the safety and reliability of the current air traffic control system. The first change would create a new modal administration within the DOT focused exclusively on delivery of air traffic control services and regulated at arm's length by the FAA. The second change would replace excise taxes on passengers, cargo, and fuel with cost-based charges on commercial and business aircraft operators. I stop short of calling for moving the ATO to a government corporation or some other (nonprofit) autonomous entity outside the government bureaucracy altogether. Although I believe such a step would be highly beneficial, it does not appear to be politically feasible at this time.

AirNav

In the near term, the Congress should move the ATO out of the FAA and make it a separate modal administration within the DOT. For ease of exposition, and at the risk of appearing presumptuous, I give this proposed new agency a name: the Air Navigation Services Administration, or AirNav. AirNav's mission, like that of the ATO, would be to serve the civil aviation industry by operating and maintaining an air traffic control system that is safe, reliable, efficient, and environmentally responsible. AirNav would be regulated at arm's length by the FAA.

As a modal administration, AirNav would be headed by an administrator appointed by the president and confirmed by the Senate. In addition, I recommend that Congress authorize the creation of a user-dominated stakeholder board to advise the AirNav administrator on capital investments and other high-level decisions.[19]

For several reasons, the start of the next presidential administration would be an ideal time to undertake this change. First, the incoming president would want to choose as a secretary of transportation someone who would make the successful formation and operation of AirNav a top priority and who would be evaluated accordingly. Second, the next president will have an opportunity to appoint a new FAA administrator, a position that carries a fixed, five-year term. Willingness to help bring about the separation of the ATO should be a condition for the appointment.

Because the ATO exists as a distinct office in the FAA with its own separate budget, its transfer to a new agency would be relatively straightforward as an organizational matter. All current ATO employees and functions would move to AirNav. Likewise, all non-ATO employees and functions, including the AIP, would remain in the FAA.

The exceptions would involve certain central office functions for which the ATO depends on other parts of the FAA (e.g., legal services) or the FAA depends on the ATO. (Because of its specialized expertise, the ATO acquisition office handles procurements for the entire FAA.) With respect to the former set of functions, I favor having AirNav staff its own central office, rather than transfer personnel

19. As one model, in its 2007 FAA reauthorization bill the Bush administration proposed a thirteen-member advisory board to the ATO, with representation from commercial aviation, general/business aviation, airports, aircraft manufacturers, government, and the public interest. The Reason Foundation has proposed a similar, fifteen-director board (Poole and Butler 2001); the Reason Foundation's proposal is preferable in that it includes labor.

from the FAA, so as to create a culture independent of the FAA's.

In addition to separating the ATO from the FAA organizationally and budgetarily, it would be preferable to separate it physically. Currently, some five thousand ATO staff, including the COO and his senior management team, work out of the FAA headquarters in Washington, DC, just a few blocks from the Capitol. Because AirNav would be an operational agency, it need not be based in Washington, DC. In fact, it might be advantageous to locate it elsewhere.

Benefits of the Creation of AirNav

The creation of AirNav, by separating the ATO from the FAA organizationally and physically, would bring several benefits. Most important, it would eliminate the potential conflict of interest by replacing the current arrangement, in which the FAA both operates and regulates the air traffic control system, with one in which the FAA provides independent and arm's length regulation of the system operator (AirNav). As discussed above, this long-needed change is becoming even more critical as the air traffic control system shifts to satellite-based technology, which allows closer spacing of aircraft.

Oster and Strong (2007) describe how the separation of the two functions (operation and regulation) would improve the current incentives. The key is transparency, as they point out:

> The same trade-offs between safety and capacity would remain and be just as technically difficult, but the regulatory tensions that are now internal to one organization would be external and between two different organizations. Decisions that are now made internally within FAA would become external in a manner similar to safety regulatory decisions in other aviation sectors. The debate about trade-offs between safety and capacity would be more public and open to outside scrutiny. The air traffic control operating organization would have to consider carefully any changes to the minimum safety standards they propose and clearly state the justification for that proposal. The regulatory organization would have to consider, specify, and defend the criteria it used for selecting one standard over another, and for accepting or rejecting any proposed changes. (Oster and Strong 2007, 153)

Second, the creation of AirNav would clarify the missions of the two organizations. The ATO is a large organization with a distinct, operational function. Making the ATO a stand-alone operational administration would help address a major challenge faced by the COO: getting employees to see their job as that of a (safety-obsessed) service provider. Allowing the FAA to focus on safety regulation should improve its performance as well.

To appreciate the importance of mission clarity, consider the current controversy over whether the FAA has gotten too cozy with the industry it regulates. A key issue is a 2003 FAA initiative that encouraged FAA regulators to treat industry more like a customer. I share the view, expressed by several members of Congress, that this stance is inappropriate: airlines and aerospace firms are the regulatees, not the customers, of *FAA regulators*. At the same time, airlines and other aircraft operators *are* the ATO's customers. Ironically, as discussed above, getting ATO employees to recognize that has been one of the COO's major challenges. This kind of confusion as to organizational mission is inevitable when the FAA performs two such different and "inconsistent" functions, and separation of the two functions would add clarity to the missions of both agencies.

Recent testimony by the FAA's CFO further illustrates the point: "At FAA, 'acting more like a business' isn't just a slogan. We are actively engaging in a comprehensive pay-for-performance program, consolidating operations, improving internal financial management, and increasing benefits to our customers. Our beacon will always be our mission—to provide the safest, most efficient aerospace system in the world. Our bottom line is results for our stakeholders, including the taxpayer and the traveling public" (Punwani 2008, 5).

The goal of "acting more like a business" is appropriate to the FAA's role as service provider. In fact, that goal was the motivation behind the creation of the ATO. However, it is not an appropriate goal for the regulatory side of the FAA: although the regulators' performance may well need improvement, they are carrying out an inherently governmental function. As with FAA regulators' use of the term "customer," the issue here may be semantic, in part: a poor choice of words. In addition, though, there seems to be some genuine confusion among rank-and-file employees about the FAA's mission—predictably so, given the agency's dual and potentially conflicting responsibilities.

Third, the elevation of the ATO to a DOT administration would make it easier to attract and retain qualified leaders. It took the FAA several years to recruit its first COO, in part because prospective hirees were concerned about the reporting relationship to and potential interference from the FAA administrator and deputy administrator. These same issues reportedly contributed to Russ Chew's decision to leave prematurely. As an administrator, the head of air traffic services would have an appropriately senior position and the greater autonomy that such a position confers.

Finally, if Congress were to authorize a stakeholder advisory board, as I propose, the creation of AirNav would yield even greater benefits. Lack of input from users, in particular, has contributed to modernization problems and the poor performance of the air traffic control system, as I have noted repeatedly. Although the AirNav administrator would not be bound by recommendations of the board, he or she would likely take them seriously.

Potential Drawbacks to the Creation of AirNav

However, there are some potential drawbacks to the creation of a separate agency for air traffic services. The major drawback is that it will likely increase the time and effort needed to reach certain decisions that the FAA can now make internally. If the ATO is a separate agency, then agreement will require an interagency process, which is more cumbersome. But some loss of procedural efficiency is unavoidable if the goal is to enhance safety by making the service provider and the regulator independent of one another.

In addition, the creation of AirNav could have the unintended effect of increasing political pressure on the air traffic control operator. In key respects, the office of the secretary of transportation is a more political environment than that of the FAA administrator. If decisions are bumped up because of disagreements between AirNav and FAA regulators or complaints from industry, the secretary's office might be more responsive to outside pressure. Conversely, though, a secretary committed to seeing AirNav succeed could give the air traffic control organization more political cover than the FAA administrator has been able to do.

Pricing

In addition to making the air traffic control system a separate DOT agency, Congress should replace tax financing of the system with cost-based prices on commercial and business aircraft operators. Under my vision of a pricing system (I do not offer a full-blown proposal), commercial operators and turbine-powered aircraft would pay a per-flight price roughly equal to the long-run marginal cost to the system. To minimize transaction costs and reflect their lower demand on the system, piston-engined aircraft, many of which operate out of separate and uncongested facilities, would continue to pay a fuel tax set at or close to the current level; alternatively, they could opt to pay a flat annual charge linked to aircraft size.

Principles

A pricing system for air traffic control services should embody five key principles.[20] First, it should

20. For an excellent analysis of the financing problem, and an interesting approach to solving it that is consistent with but more detailed than my own vision, see Kaplan (2007b).

impose charges on direct users (airlines and other aircraft operators) rather than on indirect beneficiaries (passengers and shippers), as the current tax-based system does. A system of direct charges contributes to efficiency by forcing the actual users of the system—the ones who make the decisions about the number and schedule of flights and the size of the aircraft to be flown—to take the price of the corresponding services directly into account. In principle, a system that imposes charges indirectly on passengers rather than directly on aircraft operators should lead eventually to a similar outcome. In practice, however, indirect charges offer many more opportunities for pricing signals to become attenuated or lost.

Second, the price should be based on the cost to the system so that users' decisions about scheduling and aircraft size directly reflect the resources they use. Specifically, the price should equal the marginal cost to the system: the incremental cost of accommodating each additional user.[21] If the price is set above marginal cost, it will exclude potential users who would be willing to pay enough to cover the incremental costs they impose on the system but not as much as the price being charged. Conversely, if the price is set below marginal cost it will encourage inefficiently high levels of demand by users for whom the benefits from using the system are less than the costs their usage imposes.[22]

Third, prices should reflect not just monetary costs, but also, in congested airspace, the delay costs that each user imposes on other users. Delay costs vary widely depending on when aircraft fly, whether at busy or slack times, and what flight paths and airports they use. Unless aircraft operators are charged those actual, varying costs, they will use the scarce air traffic control capacity inefficiently. However, several caveats are in order. One, some of the congestion we experience now is attributable to the perverse financing mechanism itself, which subsidizes small aircraft operations. Thus, even without a time-variant congestion component, the use of cost-based prices for air traffic control services may lead to some reduction in congestion by eliminating the current bias in favor of small aircraft. Two, as noted earlier, DOT is pursuing policies to facilitate more efficient runway pricing to address what is perhaps the biggest source of congestion—namely, scarce runway capacity. If that effort is successful, it will reduce the need for congestion pricing of airspace. Three, the sudden and relatively difficult-to-foresee reductions in capacity caused by adverse weather conditions are another cause of congestion. While such congestion is susceptible to pricing-based solutions, those solutions would differ from the ones aimed at getting aircraft operators to internalize delay costs (Neels 2002; see also Robyn 2007, 21–24).

Fourth, the air traffic control system should achieve something close to revenue adequacy. Because air traffic control systems have large fixed and common costs, adherence to a marginal cost-pricing rule may not cover the full costs of the system. Following what is common practice, I recommend that any shortfall in revenue be made up with price markups based on willingness to pay.[23] This means that highly price-sensitive users should pay prices very

21. Usage of the system changes over the course of a specific flight. One could potentially calculate a marginal cost for each phase of the flight (takeoff, terminal, en route, and landing) and impose a separate fee for each. Alternatively, one might follow what has become standard practice in many parts of the world and roll these charges into a simplified formula with a fixed fee per operation and a distance-related charge.

22. Ideally, prices should reflect the long-run marginal cost because there may well be one marginal cost associated with accommodating an additional user within the air traffic control system as it now exists, and a different (and potentially much higher) cost associated with expanding the capacity of the system to enable it to accommodate additional users. If demand is growing, each new user added to the system brings us closer to the day when capacity expansion becomes necessary, and thus should pay some portion of those eventual capacity expansion costs.

23. This approach is know as Ramsey pricing, and derives from a seminal article on utility pricing published in the 1920s by the English economist, Frank Ramsey. Ramsey pricing principles call for setting prices above marginal costs by an amount that would reflect the likelihood that usage levels would decline as a result of the change. In formal terms, Ramsey pricing would establish for each class of user a price markup over marginal cost that is inversely proportional to that user's price elasticity of demand (Ramsey 1927).

close to marginal cost, while users whose demands are less price sensitive (those who benefit most from the system) should pay prices that are above their marginal costs. To make it workable and in keeping with International Civil Aviation Organization guidelines, I recommend using aircraft weight as a rough proxy for the benefits that an aircraft operator derives from the use of the system.

Finally, on grounds of efficiency and equity, the pricing system should treat similarly situated users the same; i.e., it should not distinguish between classes of users except on the basis of costs to the system. Specifically, turbine-powered business aircraft, most of which are flown for business use, resemble commercial aircraft in the demands they place on the system. Thus, they should be subject to the same pricing regime as commercial aircraft in place of the fuel tax they now pay. That said, insofar as they use less congested airspace and facilities, as is often the case, it would be reflected in lower prices.[24]

By contrast, piston-powered aircraft, many of them flown for recreational use, place significantly less demand on the air traffic control system. Most of them use visual flight rules (i.e., they do not rely on radar) and they fly in and out of noncongested facilities. Both to minimize transaction costs and to reflect their lower demand on the system, under my ideal pricing system piston-engined aircraft would continue to pay a fuel tax set at or close to the current, low level. Alternatively, they could choose to pay a flat annual charge linked to aircraft size, similar to a pricing option that NavCanada offers to Canadian piston-powered aircraft.

Benefits of Pricing

Adoption of a well-designed system of pricing could have far-reaching beneficial effects on the air traffic control system over time. I focus here on two: the contribution to economic efficiency that market signals would make, and the improvement in governance from reduced congressional micromanagement and correspondingly increased industry involvement.

1. Market Signals

First, prices will provide valuable market signals, enhancing economic efficiency (pricing will also improve equity and revenue adequacy).

1. In the short run, when supply is fixed, prices would provide an incentive for more efficient use of scarce air traffic control capacity (what economists refer to as *allocative efficiency*). By ensuring that aircraft operators value the services they use sufficiently to pay their costs, prices would discourage inefficient patterns of use, thereby reducing system costs, including delay costs.

2. The market signals that prices provide would encourage efficient provision of air traffic control services by AirNav (what economists call *productive efficiency*). Fees paid on a per usage basis make it clear where the demand is, where revenues are being generated, and where there is both the need and opportunity to expand output. Such information would provide valuable signals to decision makers at all levels of AirNav. Does it make sense to schedule additional staff on an overtime basis? Will the revenues to cover those additional costs be forthcoming? Should staffing be expanded at a particular location? Should equipment be upgraded? Pricing would help to answer such questions.

   Moreover, under a system of prices, AirNav could offer and customers could purchase the services that best met their needs, as opposed to the current one-size-fits-all service. For example, a group of airlines might pool resources to pay

24. There is a certain degree of tension between the principle that the fixed costs of the system should be recovered from system users in proportion to aircraft weight, and the principle that similarly situated users should receive the same treatment. Such tensions arise when there are large fixed and common costs, and where as a result a purely marginal-cost-based system will fail to generate enough revenue to cover total system costs. One way to manage this tension is to calculate the *marginal-cost-based* portion of the user charge without regard to the category or characteristics of the user, but then to calculate the *markup over marginal cost* based on aircraft weight.

AirNav for extra service during peak hours. Still other customers might prefer less service in exchange for lower fees, which would be analogous to "interruptible" electricity service.

3. In the long run, a system of prices will encourage innovation and efficient investment (what economists call *investment efficiency*). With the FAA moving to a NextGen system in the coming years, the most important benefit of prices may be to guide investment and facilitate technology adoption.

   Individual FAA investments often benefit some users more than they do others. FAA makes investment decisions based on an overall cost-benefit analysis; but opposition from users who would see few benefits may impede projects that are efficient overall. A pricing system could facilitate "deals" between different user groups, resulting in investment decisions that are more efficient.

   Prices could also speed the adoption of new equipment on-board the aircraft. Many of the technical capabilities needed for NextGen already exist. But early adopters of these capabilities often take on additional risk and cost, and they receive no benefits until there is a critical mass of users. Thus, the incentive is to let others equip first. Aerospace engineers refer to this as the "first third" problem, because a third of all aircraft typically must equip before any individual user benefits (Lewis 2002).

   Equipage has been a major obstacle to FAA modernization. By offering first-adopters a discount on fees that reflected savings to the system (or by charging late adopters a higher fee, reflecting added costs to the system), the FAA could break the "first third" impasse. Canada's stakeholder-owned air traffic services provider, NavCanada, is already doing this: aircraft operators equipped with advanced "datalink" technology on oceanic routes are charged lower air traffic control fees, because NavCanada can track their location more easily.

   Finally, cost-based pricing could facilitate localized investment decisions. Individual carriers might find it economical to finance capacity-expanding or delay-reducing investments at specific airports where their operations are concentrated.

2. "User Pay, User Say"

No less important, a system of prices (i.e., user fees) would reduce opportunities for congressional micromanagement. The federal budget process treats differently revenue from user fees and revenue from excise taxes. Although there are several options for the budget treatment of user-fee revenue, most of them entail reduced congressional oversight (GAO 2008).

At the same time, pricing of air traffic control services would increase customer involvement because users would be paying for the system directly. Under the current system, as discussed above, users lack incentives to monitor FAA spending and the FAA lacks incentives to consult adequately with users. Pricing creates a link between users and service providers that goes beyond the invisible hand of the market, as summed up by NavCanada's informal slogan, "User pay, user say."

Drawbacks to Pricing?

The administration's user-fee proposal failed largely because of opposition from general aviation interests who perceived that they would be worse off. In the case of business aviation, that perception is correct. For the reasons discussed earlier, though, elimination of the current subsidy to business aircraft operators would strike a blow for equity as well as efficiency. In the case of recreational general aviation users, my approach is designed to hold them harmless. One rationale for that is safety: if recreational flyers cannot afford to pay for air traffic control services, they may resort to visual flight rules under circumstances where that is unsafe.

5. Potential Objections and Responses

Some people say that separating the air traffic control operator from FAA regulators will harm safety, contrary to what you argue. What is your response?

There is widespread agreement among safety experts and others that the two functions, operation and regulation, should be separate. The fundamental issue of how much space to maintain between aircraft involves a trade-off between safety and efficiency; that trade-off should be made transparently, which is almost impossible when the two functions reside in the same agency.

The view that separation will harm safety rests on questionable facts or logic. One claim by opponents of separation is that operation and regulation are inextricably linked in the case of air traffic control. This claim is contrary to the International Civil Aviation Organization safety principle calling for the air traffic control operator and its regulator to be separate from one another, however. This is a principle that dozens of countries have elected to follow, and with positive results. A second claim is that separation would lead to an adversarial relationship between the regulator and the operator, whereas they can work cooperatively under the current arrangement. True, a spirit of cooperation between regulator and regulatee can be productive, but separation does not preclude that spirit. The key is transparency, not antagonism. A third claim is that, precisely because the two functions are not independent, FAA regulators, aware of the potential conflict of interest, go to extra lengths to maintain safety. But this is equivalent to saying, "I don't want to install air bags in my car because I drive more carefully knowing I don't have air bags." Finally, some people claim that we should not change an arrangement that has produced such good results. While the safety record of the current system has been excellent, that is not a reason to ignore the vast evidence that points to the superiority of independent, arm's length regulation.

Note that most of the arguments against separation have been made in the context of proposals to move the air traffic control system outside the traditional government bureaucracy—proposals that were opposed on other grounds as well. Because AirNav would remain inside government, my proposal may trigger fewer such arguments.

Why do you want to leave the AIP in the FAA? Doesn't it belong with AirNav?

AIP is a grants program that targets smaller airports with the primary goal of promoting economic development. Its mission is not consistent with that of an agency (AirNav) devoted to providing a business-like service. Granted, some AIP grants address genuine capacity needs of the air traffic control system. Thus, AIP program managers may need to coordinate with AirNav. But, they can do that across agency lines, much as the FAA coordinated with the Department of Defense on its grants program to convert shuttered military airfields to civilian airports.

Why not move the air traffic control system out of the traditional government bureaucracy altogether?

In my view, it would indeed be preferable to move the ATO to a government corporation or some other (nonprofit) autonomous entity outside the traditional government bureaucracy. Such a step does not appear to be politically feasible at this time, however.

The benefits of autonomy have been spelled out at length by Oster and Strong (2007), Poole (see, for example, 2006 and 2007), and others, as well as in the 1995 Clinton administration report recommending the creation of the U.S. Air Traffic Services, Inc. (Kruesi 1994). An autonomous organization can focus more than a traditional government department on satisfying its customers. In addition, the absence of political micromanagement and the ability to access capital markets directly mean that a nongovernmental or quasigovernmental agency can more successfully develop and adopt new technology.

The best evidence in support of autonomy is the trend in the rest of the world. Several dozen countries, including most industrial countries, have divested the air traffic control service provider from the aviation regulatory agency. Typically, they have done this by creating a nongovernmental or quasigovernmental entity that has autonomy in terms of its finances and governance. Although the major motivation for this change has been to allow the air traffic control service provider to adopt business practices that are more commercial, an explicit secondary goal has been to enhance safety by putting the regulator and the service provider at arm's length.

Oster and Strong's book (2007) provides by far the most thorough and thoughtful analysis of alternative approaches to the provision of air traffic control services. Drawing on their own detailed case studies of Air Navigation Service Providers (ANSPs) in more than a dozen countries, they identify the relative strengths and weaknesses of four approaches:

- a government corporation, such as Airservices Australia and Airways New Zealand;
- a nonshare capital corporation such as NavCanada;
- a public-private partnership, such as the United Kingdom's National Air Traffic Services; and
- a traditional government agency, such as the FAA.

Although there are no examples of this approach to date, Oster and Strong also assess the potential strengths and weaknesses of a private for-profit ANSP.

Oster and Strong (2007) conclude that the two organizational forms at either end of the spectrum—the government agency and the private corporation—are the least well suited to providing air traffic control, but for different reasons. In their view, the other three organizational forms (the government corporation; the nonshare capital corporation, also known as a stakeholder-owned cooperative; and the public-private partnership) have similar strengths and weaknesses and can each be effective if carefully designed and implemented (198–99).

GAO's much more limited review of five "commercialized" providers (Australia, Canada, Germany, New Zealand, and the United Kingdom) produced equally positive results: "Data from all five indicate that safety has not eroded. . . . All five ANSPs have taken steps such as consolidating facilities, to control their operating costs. Finally, all five ANSPs have invested in new technologies that the ANSPs say have lowered their costs by increasing controllers' productivity and produced operating efficiencies, such as fewer or shorter delays. Such measures have generally resulted in lower fees for major carriers, but some smaller, formerly subsidized users now pay new or higher fees and are concerned about future costs and service" (GAO 2005a).

Despite the promising trend elsewhere, the concept of an autonomous air traffic control provider faces overwhelming opposition in this country. The air traffic controllers' union, which supported the Clinton administration's government-corporation proposal, opposes any move toward a more commercial air traffic control system (Oster and Strong 2007, 176–77). In addition, the politically powerful trade association that represents recreational flyers opposes giving the air traffic control provider autonomy, for fear it would lead to higher charges.

How does your vision for a system of cost-based user charges (pricing) differ from what the Bush administration proposed in 2007?

The Bush administration proposed replacing excise taxes on passengers and cargo with cost-based user fees. Although the legislation did not specify the exact fees and it maintained flexibility for the FAA, it provided a fairly detailed framework for a pricing system.

The administration's proposal was generally consistent with my set of principles, with two exceptions. First, it did not impose user fees on high-performance business aircraft operators: under the administration's proposal, noncommercial, turbine-powered aircraft would continue to pay for air traffic control services via a fuel tax, albeit at a significantly higher rate. I see no valid economic or policy rationale for preserving the separate treatment of high-performance business aircraft, given that they make similar demands on the system as commercial aircraft and, in fact, increasingly represent a competitive alternative to commercial travel for well-heeled corporate executives.

Second, the administration's proposal was based on a calculation of average costs, whereas I favor the use of marginal costs. To be fair, the marginal costs of air traffic control usage are not yet well understood. Over the years, the FAA has commissioned several studies of this subject. These studies have attracted considerable criticism, and a reliable consensus regarding the relative costs generated by the various air traffic control users has yet to emerge. The FAA has invested considerable resources in efforts to improve its cost accounting procedures and bring them to the point where they can provide actionable estimates of marginal costs. As of this writing, however, this effort remains a work in progress.

Given the limits of our current understanding of marginal user costs, cost-based user charges may initially reflect only rough approximations. Even a rough approximation such as this, however, would represent a considerable step forward in terms of system efficiency. Moreover, it is reasonable to expect our knowledge of marginal system costs to improve over time. Systemwide estimates of marginal cost might, for example, eventually be replaced with location-specific estimates or estimates based on the time of day. Over time the sophistication of the prices can be expected to improve, and with it the efficiency benefits.

Why should turbine-powered business aircraft be treated the same as commercial aircraft? Aren't they "marginal" users of the system, imposing few added costs?

As a factual matter, the oft-heard claim that business aircraft account for only an insignificant fraction of system usage and cost is simply untrue. A recent analysis by the DOT inspector general found that non-air carrier jets (a category of users that is roughly equivalent to business jets) used about 12 percent of all tower services and 13 percent of all terminal services in 2005. Those levels of usage are about one-third of the comparable levels for air carriers (commercial and charter aircraft). A narrower category of business jets, which excludes air taxis and fractional jets, used about 9 percent of tower and 7 percent of terminal services (DOT 2008c, 5-6 and Tables 1 and 2). The inspector general concluded that business jet operators make sufficient use of the air traffic control system so as to materially contribute to FAA's costs and congestion in general (DOT, 3).

Granted, if turbine-powered business aircraft were suddenly to disappear, we would still need to have a complex air traffic control system to serve the needs of commercial users. However, it is by no means clear that such a system would need to be as large, capable, or costly as the system that currently exists. Going forward, turbine-powered business aircraft may represent an even more significant driver of capacity needs and system costs. As discussed above, the high cost of NextGen is driven in part by the perceived need to accommodate projected growth in the number of very light jets.

Would a shift to cost-based pricing of the air traffic control system really affect the way airlines use the system?

This is an important question that economists need to investigate empirically, but I believe the answer is "yes." Anecdotal evidence suggests that U.S. airlines are highly price sensitive. For example, according to Susan Carey's article in the *Wall Street Journal* on March 6, 2007 ("How Flight-Planning Software Helps Airlines Balance Fuel, Distance, Wind, 'Overfly' Fees"), airlines use a commercial software program that tells them whether it would be cost effective to fly through Canadian airspace, based on the combination of gas savings and NavCanada fees. Moreover, Kaplan (2007a) has developed some stylized examples that show that a shift to a movement-based charge would change the relative profitability of operating a Boeing 737 with more than one hundred seats versus a seventy-seat RJ.

Would AirNav be completely self-supporting?

In its 2007 FAA reauthorization bill, the Bush administration proposed continued general fund support for three services provided by the air traffic control system: services provided to the military and other public users; low activity towers, which give many small communities access to the aviation system; and flight service stations, which provide weather and other services to recreational pilots. I am comfortable with that proposal.

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