Advances in Airline Economics, Vol 2
Darin Lee (Editor)

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Toward Rational Pricing of the US Airport and Airways System

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ABSTRACT

The taxes and fees flights presently pay for use of the airports and airways in the United States presently bear little relationship to the cost of providing those services. As a result these prices generate significant distortions. Most notably, the present system of prices actually subsidizes flights operating at congested airport, and thereby foster delay. If the prices of the airport and airways system better reflected costs, there would not only be fewer delays, but more prudent investment decisions as well. This chapter considers how such a pricing system might be implemented and estimates the subsidies and overcharges to commercial aircraft operating at New York's LaGuardia airport in 2004.

1 INTRODUCTION AND OVERVIEW

For decades, US airlines have complained about the delays and the costs at the nation's airports, as they fretted about the pace of improvements to the Air Traffic Control (ATC) system. These concerns have spawned a variety of policy proposals ranging from the imposition of congestion fees to the privatization of airports and the ATC system. Regardless of their merits, these proposals all face substantial political opposition. For example, air carriers believe they already pay too much for airport services, and therefore, wholeheartedly resist paying yet another charge. Organized labor, meanwhile, wants to keep ATC jobs in the public sector.

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[1] The author appreciates the comments of Darin Lee and David Gillen and the assistance of Zachary Kaplan. The chapter has benefited from conversations with Sandy Rederer, Mark Kahan, and Dorothy Robyn.

Despite the various complaints about the performance of the airport and airway system, there has been surprisingly little analysis of the prices users are currently paying.[2] Price plays a central role in the efficient operation of a market by determining how much is produced and how that output is allocated. Price serves neither function in the case of the airport and airways system. Because prices for airport and airways services bear little relationship to cost, they actually foster delay by subsidizing low-valued services at congested facilities. Moreover, the system charges different users vastly different prices for the same service, thereby suppressing an important indicator of the value of additional capacity and distorting investment decisions. More rational pricing, therefore, has the potential not only to produce short-run gains at congested facility, but lead to more sensible long-run investments.

Various government agencies in the United States (federal, state, and municipal) own and operate the airports and the ATC system, and there are significant monopoly elements in the provision of these services. Consequently, as either an owner or regulator, the continued role of the federal government in the pricing of the airport and airways system is virtually assured. A range of alternative pricing systems would likely lead to significant efficiency gains. In addition to discussing the deficiencies of the existing system, this chapter advocates a particular approach to pricing, which should reduce many of the existing distortions and could be implemented at relatively low cost. The potential impact of the new system is illustrated by considering the effect its adoption would have on prices currently paid by flights at New York's LaGuardia Airport. Key features of the proposed system include:

- Airport and airways services would be segregated into three separate activities and users would face charges for each. In addition to a fee for the use of an airport's airfield, a flight would pay distinct fees for terminal services at each airport as well as for the en route control services it uses in traveling between them.
- Flight operators would pay a price at least equal to the average variable cost (an approximation of marginal cost) of the relevant services, although those flying during periods when a facility is congested would pay more than users during uncongested periods.
- Total revenue from the fees for any service would not exceed the operating costs of providing that service. Though aircraft operators would pay higher fees at certain periods, users during less congested periods would pay less. Accordingly, the proposed system does not involve congestion fees as the term has typically been used.
- All system users would face the same set of fees, ending the existing distinction both between passenger and freight carriers and between commercial and private aviation.
- Because airports and the ATC system offer complementary services, prices for both would be jointly established.

This chapter consists of seven additional sections. Section 2 provides an overview of the taxes and fees aircraft operators currently pay for the use of the airport and airways system. Using FAA data, Section 3 provides rough estimates of the cost of

[2] Michael Levine, however, did consider a number of these issues in an article in the 1960s. See "Landing Fees and the Airport Congestion Problem," *Journal of Law and Economics* XII (April 1969), pp. 79–108.

providing these services and highlights the wide discrepancy between costs and price. This misalignment is largely caused by prices being more closely tied to the value of the service to the user than the cost of producing the service. Section 4 discusses some basic issues the federal government should consider in designing a new price framework including the complementarities between ATC and airport services. Section 5 describes the proposed pricing system.

New York City's LaGuardia Airport is one of the nation's most congested, and Section 6 estimates the gap between the prices paid by different flights and the costs of the services they receive under the existing system of charges. Though passenger carriers overall pay substantially more than the cost of the service they receive, a move to a more cost-based system would reduce the profitability of a substantial number of LaGuardia flights. Thus a move to a more cost-based system could reduce congestion at the same time that it reduced the overall amount carriers paid for the use of the airport and airways system. A concluding section offers some remarks about implementing the new system along with a discussion of the special treatment that might be afforded to flights serving small communities as well as for some private aviation.

2 EXISTING TAX AND FEE SYSTEM

Two sets of agencies provide airport and airways services. The major (but certainly not the exclusive) role of the Federal Aviation Administration (FAA) is providing ATC services. The FAA is financed by general fund revenues as well as a variety of aviation taxes flowing through a trust fund. Receipts from these aviation taxes, however, reasonably approximate the cost of ATC services. These ATC services are provided in conjunction with the services of airports, which are, for the most part, owned and operated by various municipal governments. Airports provide a variety of services, but the analysis here focuses exclusively on the airfield. Airports have traditionally recovered these airfield costs through landing fees.

2.1 Federal Aviation Administration

A combination of general fund revenues and aviation related taxes fund the ATC system. Technically, these taxes are paid into the Airport and Airway Trust Fund (Trust Fund), and the Trust Fund is the FAA's major funding source. The Congress established the Trust Fund in 1970 to procure navigational aids and to develop airports. Since it established the Trust Fund, Congress has changed some rates and created some new taxes, but the present panoply of aviation taxes is largely consistent with those originally adopted.[3] Though the taxes have remained more or less the same, the Trust Fund's role has changed significantly. Now most Trust Fund revenues are used to underwrite the FAA's operations, with only a portion devoted to the Trust Fund's original purpose

[3] There were aviation taxes prior to 1970, but these taxes went directly to the general fund. By creating the Trust Fund, the airlines hoped they would benefit directly from the fees they paid.

Table 1 Aviation Excise Tax Revenues, FY 2004 (In Millions)

Excise Tax	Domestic Passenger	Domestic Freighter	General Aviation	Foreign Carriers	TOTAL
Domestic passenger ticket tax	$4,813		$52	$64	$4,929
Domestic flight segment tax	$1,706		$20	$21	$1,747
International arrival and departure tax	$793			$746	$1,539
Domestic cargo and mail	$28	$452		$4	$484
Fuel tax	$423	$60	$317	$9	$810
Alaska-Hawaii	$59			$12	$70
TOTAL	$7,893	$512	$317	$856	$9,579
Percent of total	82.4%	5.3%	3.3%	8.9%	
Percent of domestic	90.5%	5.9%	3.6%		

Note:
1) Fractional ownership payments of $51.9 million in Ticket Tax; $20.2 million in Segment Tax; and $8 million in fuel taxes are included under General Aviation.
2) The tex rate for commerical fuel is 4.3 cents per gallon, and the tax rate for general aviation av gas is 19.3 cents per gallon and 21.8 for jet fuel.
Source: FAA.

of underwriting infrastructure investments.[4] Operating the ATC system is the most significant of the FAA's activities, but it also oversees airport improvements and the safety of aircraft and airlines, in addition to performing a variety of other aviation services.[5]

Receipts from nearly a dozen aviation related taxes flow into the Trust Fund, and they totaled over $9.58 billion dollars in FY 2004, of which $8.04 billion were raised by taxes on domestic service (Table 1).[6] The tax rates applicable to any given flight, however, depend very much on its purpose. Flights by a commercial passenger carrier, a freight operator, and a corporate jet, each making precisely the same demand on the ATC system pay very different amounts.[7]

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[4] See Federal Aviation Administration, "Budget in Brief, Fiscal Year 2006." Trust Fund revenues pay for the FAA's capital expenditures (specifically outlays for the Airport Improvement Program and for Facilities and Equipment) with the balance of Trust Fund revenues to be used to support FAA operations. In recent years, however, the budget has established a Trust Fund contribution to the FAA, which has exceeded Trust Fund revenues. As a result, the uncommitted balance of the Trust Fund has been reduced. (The General Fund contributed 26 per cent of the FAA revenues in 2004.) Also see General Accounting Office, *Airport and Airway Trust Fund*, GAO-03-979, September 2003, p. 12.

[5] The ATO, a public benefit corporation, was established in 2004 to incorporate functions relating to operating the ATC system. It does not have a separate funding source.

[6] This is approximately equal to the FAA expenditures on operating the ATC system. Expenditures on ATC are not the same as operating costs, because the federal government does not distinguish between current and capital expenditures. International flights use some of the same services consumed by domestic flights.

[7] Users of the transportation service nominally pay some of these taxes. Nevertheless, the identity of the person paying a tax has relatively little to do with the incidence of the tax. The following discussion assumes all taxes are paid by the entity operating the flight, which is unlikely to be the case.

The ticket tax, which is a 7.5 per cent tax on domestic airfares, accounts for over half of the revenue generated by the various Trust Fund taxes.[8] Commercial passenger carriers also pay a $3.10 per passenger segment tax. Carriers transporting cargo domestically, whether by freighter or in the belly of a passenger aircraft, pay a 6.5 per cent fee on the value of the air transportation provided. In addition, commercial carriers also pay a 4.3 cent per gallon fuel tax. General aviation flights, on the other hand, pay only a fuel tax: 21.8 cents per gallon for jets and 19.3 cents per gallon for non-jets.

The taxes on passenger and cargo revenues are valued based: taxes are tied to the amount the passenger or shipper pays for air service, which in turn is a reasonable approximation of the value consumers attach to the service. While not as directly tied to value, the segment tax is also value based because the amount paid increases with the number of passengers, and the more passengers onboard the greater the value of the flight. Even the amount a flight pays in fuel taxes is highly correlated to a flight's value, because larger aircraft not only carry greater numbers of passengers but they also burn more fuel. Likewise both fares and fuel use tend to be correlated with distance.

While within any category of flights, the taxes paid by a flight tend to be highly correlated with its value, there may be little if any correlation between taxes and values across categories of flights. In 2006, a general aviation jet flying from New York to Los Angeles paid $545 in fuel taxes, while a commercial B-767 flying the same route and using the same ATC services paid $2,500 dollars more.[9] More generally, commercial passenger airlines, however, pay 90 per cent of the taxes associated with domestic aviation taxes, while accounting for only 60.7 per cent of the flights and 70.3 per cent of the flying hours of the principal users of the air traffic control system (Table 2).[10] This disparity between their share of taxes and their share of activity has prompted claims of unfairness by, among others, the major carriers' trade association.[11]

[8] For all the Trust Fund taxes as of March 2006, see "Current Aviation Excise Tax Structure" on the Federal Aviation Administration Website (http://www.faa.gov/about/office_org/headquarters_offices/aep/aatf/media/Simplified_Tax_Table.xls).

[9] James C. May, "Smart – and Fair – Skies: A Blueprint for the Future," Speech to the International Aviation Club, Washington, DC, April 18, 2006. (http://www.airlines.org/news/speeches/speech_4-18-06.htm). The Air Transportation Association, the trade group of the commercial carriers, calculates that a Buffalo to Philadelphia roundtrip flight on a commercial carrier would pay $900, while a business aircraft could pay as little as $22. Wall Street Journal, June 1, 2006. p. 1.

[10] The output estimates include only those flights captured in the Enhanced Traffic Management System (ETMS), which records ATC use of flights operating under instrument flight rules (IFR). IFR flights tend to be the most intensive users of the en route control system. Though the vast majority of commercial passenger flights are recorded by ETMS, it includes about 35 per cent of general aviation flights. See Federal Aviation Administration, "Air Traffic Organization: Airports Data for Stakeholders, November 15, 2005."

[11] For Fiscal 2004, the Air Traffic Organization, which operates ATC, accounted for approximately 75 per cent of ATC outlays. See Federal Aviation Administration, *Performance and Accountability Report, FY 2004,* p. 90. (http://www.faa.gov/about/office_org/headquarters_offices/aba/offices/financial_management/performance_accountability/media/2004_PAR.pdf) The aviation taxes fund FAA activities other than ATC operations.

Table 2 Use of Air Traffic Control for Domestic Service, FY 2004

User Classification	Flights	En Route Activity	
		Miles Flown	Hours
Passenger carriers	10,746	6,098,171	15,933
Freighters	901	458, 328	1,257
Fractionals/non-sched part 135	1,809	644,476	2,211
General aviation-turbine	2,884	659,734	2,063
Other	1,361	343,393	1,204
TOTAL	17,701	8,204,101	22,668

Source: FAA.

When it originally established the aviation taxes, Congress probably gave little consideration to the relative benefits and burdens they imposed on various segments of the industry. In any case, the regulatory structure established by the Civil Aeronautics Board almost certainly limited the impact of the taxes on either fares or service.[12] Moreover, private business jets were not very plentiful, and the express cargo services (i.e., services provided by the likes of Federal Express and UPS), which account for the bulk of the freighter service in the United States, had yet to be introduced. In short, in developing the current array of taxes, the government could not have possibly conceived the uses of the airspace or the demands on the system in the twenty-first century.

The aviation taxes were also established with little regard for either the cost of operating the ATC system. Nevertheless, in fiscal 2004 the revenues generated by these taxes were roughly in line with FAA expenditures on ATC. As noted previously, FAA generated \$9.58 billion in 2004 taxes, which was less than 3 per cent higher than ATO expenditure. This comparison, however, overstates the correspondence between the two. Both the revenue and cost estimates include international service, and this analysis focuses on domestic services. In addition, the FAA records expenditures but not operating expenses, and the actual operating costs could be significantly different. Accordingly, this analysis proceeds on the assumption that the existing aviation fees pay for the operation of the ATC and the other FAA activities are funded with revenues from the general fund. This chapter's inquiry, therefore, focuses on the issues surrounding the development of a more sensible and efficient method of collecting the revenues currently derived from the aviation taxes.

[12] A person will only take a flight if the value attached to the flight exceeds its price, and the difference between a flight's value and revenue is equal to its consumer surplus. The value of a flight to consumers, therefore, cannot be lower than the flight's revenues. The percentage by which the value of the flight will exceed its revenues depends on, among other things, the elasticity of demand and passenger fares. The following discussion assumes that the revenues among flights are highly correlated with the value of the flights.

2.2 Airport Fees

In addition to a variety of subsidiary services, airports provide an airfield for aircraft landing and take-offs.[13] The United States' Department of Transportation (DOT) has established a policy with respect to airport rates and charges that, among other things, require airports to establish landing fees that do not exceed the cost of the airfield[14] (DOT defines the airfield to include the runways, taxiways, and various other parts of airport properties). Though not required by DOT, airports, almost without exception, recover the cost of operating the airfield with a weight-based landing fee.

While weight-based landing fees recover the cost of the airfield, the fee for any given flight does not necessarily reflect the cost of accommodating that flight.[15] Instead the fee paid by any flight tends to be tied to the value of that flight. Heavier aircraft generally carry more passengers and more cargo, and consequently they generate more value. In that regard, landing fees resemble FAA taxes. Unlike the FAA taxes, however, aircraft regardless of purpose are subject to the same weight-based fees.

3 THE COST OF AIRPORT AND AIRWAYS

Because economic efficiency requires prices to be aligned with costs, an understanding of both the output of the airport and airways system and the effect of variations in output on costs is a prerequisite to the development of a sensible system of charges. The current aviation taxes not only bear little relationships to cost, but the taxes are not even levied on the output of the system, which is an aircraft movement. This section begins by defining an aircraft movement for the purpose of developing an alternative price system and provides cost estimates of ATC services. The airport and airways system produces a service, which cannot be stored. The cost of a service, therefore, very much depends on the number seeking to use the service at any time.

3.1 Defining Output

Price allocates goods and services among consumers and signals producers as to how much to produce. Though flight operators presently pay to use the ATC system, these

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[13] An airfield is only one part of an airport. Airports also facilitate passenger movement to and from flights as well as provide airlines with the space and facilities for needed services. If an airport operator was able to earn sufficient rents from airlines, passengers, and concessionaires for the use of the terminal and parking facilities it could conceivably recover its costs even if it offered use of the airfield at no charge.

[14] Airports also establish rates and charges for non-airfield services, but these are not part of providing airport and airway services, and they are not considered here. See, Department of Transportation, "Policy Regarding Airport Rates and Charges," *Federal Register Vol. 61, No. 121, p. 31994.*

[15] In addition, to landing fees, most major airports also levy a Passenger Facility Charge (PFC) of up to $4.50 per departing passenger to fund capital projects. PFCs, unlike landing fees, are not calibrated to recover a particular set of costs but represent a source of funds for airport capital projects. Some of these projects relate to the airfield and others relate to terminal improvements. PFC payments among flights do not seem to be particularly aligned with the demands those flights place on the infrastructure. It would undoubtedly increase system efficiency if PFCs were incorporated into the proposed pricing system. This, however, is not explicitly considered here.

payments do not directly correspond to the service the aircraft operator purchases. For example, the ATC system guides flights between airports, yet the largest component of the price depends on the revenues generated by that flight, which is only remotely related to the cost of the service provided. The use of taxes unrelated to output is a common method of financing the provision of public goods, such as police services, with large spillovers. It is not appropriate, however, for essentially private transactions such as an aircraft operator purchasing ATC services.

A market is where the purchasers and producers exchange some consideration, usually money, for a good or service. For a market to operate efficiently, the output of the good or service should be clearly defined and the price paid by the consumer and received by the producer should be directly related to the amount being produced. Because the airport and airway system enables aircraft to travel between places, the most appropriate definition of output is an aircraft movement.[16] In the present context, an aircraft movement incorporates both a landing or take-off at an airport and an aircraft's flight between airports.[17] En route control can be best measured in terms of time, although mileage can be used as a reasonable approximation.

There is an element of imprecision in defining the output of airport and airways system as simply aircraft movements.[18] For example, heavier aircraft often require runways that are both longer and have more reinforcement; they may also require greater taxiway clearance. In other words, an airport with a capacity to accommodate 50 regional jet operations per hour would not be able to handle the same number of widebody jet (i.e., Boeing 747) operations. In addition, with the present technology, aircraft travel between airports along designated traffic lanes, and the capacity of these lanes are similarly affected by the size of the aircraft. Factoring in aircraft size, however, would likely affect long-run and short-run costs differently. Despite the higher cost of building an airfield built to accommodate larger aircraft, the variable costs of operating the airport would remain quite small regardless of the size of the aircraft using it. The effect of aircraft size on operating costs is not explicitly factored into this analysis, and including the effect of aircraft size on costs would be unlikely to have a material effect on the welfare gains from adopting a new system.

3.2 Defining Cost

The FAA does not report operating costs like firms in the private sector.[19] While the FAA distinguishes between expenditures made on "facilities and equipment" and from those on operations, it does not report the useful lives of its assets nor does it incorporate

[16] Airport policies with respect to the pricing of non-airfield services are not nearly as uniform. Because the various airports provide disparate non-airfield services and because of the wide array of contractual arrangements between airports and flight operators, it would likely be counterproductive to attempt to dictate a price-setting mechanism.

[17] As discussed below, ATC includes both control of aircraft in the terminal areas surrounding airports as well as the control of airports traveling between terminal areas.

[18] For some short flights, the terminal area where the flight originates is adjacent to the terminal area of the flight's destination. Flights between such terminal areas do not require en route control.

[19] Federal Aviation Administration, Air Traffic Organization, "Data Package for Stakeholders", November 15, 2005.

an interest charge. Consequently, calculations of fixed costs are imprecise. Most major airports, on the other hand, report financial results consistent with private sector practices. To begin with, most airports rely on capital markets to fund projects, and they must comply with various accounting processes in reporting their results. Moreover, the cost of operating an airfield is little affected by the number of operations, and thus virtually all the operating costs of the airfield are fixed. The efficiency of any cost-based pricing system can be improved by making the data more accurately reflect the cost of service.

3.2.1 ATC

Establishing prices to recover costs requires estimates of both the costs to be recovered and the output to be produced. Combined with an understanding of the relationship between how costs change in response to fluctuations in output, these data permit the calculation of prices necessary to recover the costs. Estimates of the relevant rates are determined by using data provided by the FAA. These rates are subsequently used in Section 6 to analyze the costs of service at LaGuardia.

Identifying Cost Pools. Table 3 provides an overview of FAA's costs of operating the ATC system. The FAA has grouped its 615 operating facilities into three functional areas, and for each it has established four categories of costs. For each facility, it distinguishes between capital expenditures and other expenditures, which are for the most part, labor.[20] For the purposes of the current analysis, we assume non-capital expenses at a facility to be variable.[21] The FAA also allocates its administrative and overhead costs to each operating unit, and this analysis treats these overhead costs along with capital expenditures as fixed. This analysis focuses on establishing prices to recover the costs associated with terminal control and en route control. The costs associated with

Table 3 Overview of Air Traffic Control Costs, FY 2004

Facility Type	Number of Facilities	Noncapital Operating Expenses of Facility	Capital Expenditures on Facilities and Equipment	Overhead Expenses	Total	Percentage of Costs which are Variable (%)
		(in millions of dollars)				
Total en route	26	2,016	1,333	803	4,152	48.5
Total terminal	528	2,342	1,462	822	4,626	50.6
Flight station	61	375	60	119	554	
ATC TOTAL	554	4,358	2,795	1,625	8,777	

Note: Honolulu (en route and terminal) is counted as one facility under terminal
Other costs are included in overhead.
Source: FAA.

[20] Also included with expenditures on equipment and facilities are contract expenditures for weather.

[21] It is likely that at least some of these so-called variable costs do not vary with output and should be classified as fixed. For example, during off-peak periods a facility that is staffed at a minimum level may not have to add personnel to handle additional flights.

the operation of Flight Stations as well as other FAA activities, such as licensing and safety expenses, would need to be funded through either a dedicated set of taxes and fees or general fund revenues.[22]

Terminal control guides aircraft approaches at an airport as well as controlling take-offs and landings. At many airports, a radar terminal provides both functions. In areas with several airports (including military as well as civilian), terminal radar approach control (TRACON) provides approach control while a limited radar tower handles the landings and take-offs. Of the 500 airports in the United States, 200 have a radar tower or a limited radar tower operated in conjunction with a TRACON.[23] Ninety-five per cent of commercial passenger operations occur at these airports.[24] Other airports have more limited service. For example 73 airports have VFR Towers, which control landings and take-offs but not approaches. Other towers are staffed by contract employees, while some have no staff at all and provide only automated services.

In recovering the costs of terminal control, separate cost pools could be established for each of the more than 500 facilities or, as is done here, all the facilities could be lumped together into a single cost pool. Alternatively, several separate cost pools could be established by combining various facilities with similar characteristics, for example, size or location. Limiting the number of cost pools would make the ratemaking process more transparent to users and easier to administer.

En route control involves both domestic and international operations. This analysis does not explicitly consider international services, but in practice one or more separate cost pools could be established for international service.[25] The system would likely be most efficiently administered if the costs of domestic en route control were allocated to a single cost pool. Aircraft regularly use tens of thousands of routings, and each flight path requires a unique set of control services. With multiple cost centers, each routing would potentially be subject to a unique charge, increasing administrative difficulties and making price signals unnecessarily opaque to system users.

Computing Unit Costs. In FY 2004, ATO spent $8,777 million on Terminal and En route control, with 47.3 per cent of the total dedicated to en route control. For both activities, the non-capital expenditures at each facility were assumed to be variable and to represent one-half of the total cost. Table 4 calculates the unit costs by dividing the costs of operating the relevant ATC service in 2004 by the number of operations. On average, the terminal control cost per landing or take-off was $130.67 and the cost of the en route control was $171.01 per hour.[26]

[22] Flight Service Stations consist of 58 facilities that provide weather briefings, flight plan filing services, and other assistance to private pilots. The cost of operating these facilities was $554 million in 2004, although the FAA expects to reduce those costs significantly by turning their operation over to a private contractor. See Robert W. Poole, Jr, "Outsourced Flight Service Stations Save FAA $2.2 Billion," Reason Foundation Commentary, September 1, 2005. (http://www.reason.org/commentaries/poole_20050901.shtml.)

[23] See "Data Package for Stakeholders," p. 8.

[24] In contrast, 35 per cent of general aviation operations occur at these airports. Around 60 per cent of general aviation flights provided in jet aircraft (which for these purposes include fractional ownership aircraft) operate at these large airports. *Ibid*, p. 10.

[25] For example, separate international cost centers could be established for the Atlantic, Pacific and Latin America.

[26] A flight requires terminal operations at the departing as well as the arriving airport.

Table 4 Unit Costs of Air Traffic Control, FY 2004

ATC Operation	Cost ($)	Landings and Take-offs	Hours En Route	Unit Cost ($)
		(in thousands)		
Terminal control	4,625,900	35,402		130.67
En route control	3,876,500		22,668	171.01

Source: Tables 2 and 3.

3.2.2 Airports

Though the costs of operating the various ATO facilities providing terminal control (or for that matter, en route control) can be combined into a single cost center, the operating costs of the various airports cannot be similarly aggregated. The various airports are owned and operated by separate entities, each of which have made financing and other commitments tied directly to the operation of the facility.[27] Thus, airfield cost pools will continue to be calculated as they are presently. As discussed in detail below, however, the method for recovering those costs will change for some airports.

3.3 Effect of Demand on Cost

Because airport and airway services cannot be stored, average cost pricing may not be a reasonable method of recovering costs. Excess capacity at 5 a.m. is of little value to some one wanting to fly at 5 p.m. Faced with insufficient capacity to serve peak period demand, an operator would have to ration the available supply in the short run. In most markets, price is that rationing device, but where the price mechanism is suppressed, other rationing devices evolve. In the case of the airport and airways system, that mechanism is delay.[28]

It is generally efficient for peak period users of a facility to pay more. Peak period demand determines the size of a facility – a smaller facility could accommodate demand if the use of the facility were spread evenly throughout the relevant time period. Thus a facility operator could profitably expand the size of a facility if two conditions were met: 1) the facility could not otherwise accommodate peak period demand and 2) the revenues generated as a result of the added capacity were sufficient to recover the cost of the added capacity. Because extra capacity is required to accommodate peak period demand, the peak period users should bear the additional cost.[29]

The addition of a flight during a peak period increases the delays experienced by existing users without affecting the costs of producing the service provided. Thus, a

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[27] Some entities, for example the Port Authority of New York and New Jersey, own and operate several airports.

[28] High prices encourage suppliers to expand output. In the absence of price, mounting delays prompt expansion decisions. Delay statistics, however, do not provide the same quality of information as price. Consider, for example, the case in which delay is caused by low value users.

[29] See, for example, W. Kip Viscusi, John M. Vernon, and John E. Harrington, Jr, *Economics of Regulation and Antitrust,* 2nd Edition (MIT Press: Cambridge, MA. 1995) pp. 399–403.

transaction involving two parties (an aircraft operator and the airport) imposes costs on those not party to the transaction. This phenomenon, commonly referred to as an externality, is discussed below.

4 BASIC PRINCIPLES UNDERLYING A NEW PRICING SYSTEM

Competitive markets generally produce efficient outcomes. They provide consumers with low prices by forcing prices down to producers' costs and by forcing producers to operate at low costs. Markets for airport and airways services, however, are not competitive. Neither ATC nor airports face much competition, and the facilities are government owned and operated. Relying on the competitive market is, therefore, not an alternative, and the federal government will continue its major role in either establishing or regulating prices of airport and airways services for the foreseeable future.

Competitive markets efficiently allocate goods and services by providing both consumers and producers with meaningful signals to guide their consumption and production decisions. The existing prices for airport and airways services bear virtually no relation to the cost of service, and accordingly, do not provide any guidance to producer or consumers as to their efficient allocation.

Numerous government agencies have designed regulatory regimes to encourage firms with market power to make price and output decisions consistent with the regulators' notions of social welfare.[30] These efforts, however, have met with only limited success. The pricing mechanism proposed here advocated has much more limited goals; it seeks to create a new set of prices that lack the perverse incentives of the current system.

The proposed pricing regime does not treat congestion (and the resulting delays) as an externality, and therefore, an inevitable consequence of providing airport and airways services. The political process – and not the underlying supply and demand conditions – is preventing government agencies from establishing market-clearing prices. The existing economic literature has mistakenly categorized the inability of the political process to craft a satisfactory pricing mechanism as a market failure.[31]

4.1 Basic Criteria for More Efficient Prices

As both a producer and a regulator, government agencies should strive to establish prices consistent with economic efficiency. In the absence of externalities, competitive markets establish efficient prices by establishing prices equal to marginal cost. Moreover, such prices generate sufficient revenues to cover a firms' operating costs.[32] In addition, the

[30] For a discussion of the regulation of industries from electric power to trucking, see Viscusi et al. op.cit., pp. 377–652.

[31] See, for example, Christopher Mayer and Todd Sinai, "Network Effects, Congestion Externalities, and Air Traffic Delays: Or Why All Delays are Not Evil," *American Economic Review* 93 (September 2003), pp. 1194–1215.

[32] Competitive prices cover the costs of efficient firms. The efficiency of government operated enterprises relative to private firms is not considered here.

new pricing scheme should require prices to be reset periodically to reflect changes in costs and demand. It should also reflect the complementarities between airport and ATC services.

4.1.1 Establishing Prices Equal to Costs

Economic efficiency very much depends on the relationship between price and marginal cost.[33] With price equal to marginal cost, the value a purchaser attaches to an additional unit of output just matches the cost of the resources needed to produce that added output. A government agency charging such cost-based prices may be unable to generate revenues sufficient to recover fully the costs it incurs in producing an efficient level of output. This is most likely to be a complication where economies of scale are present. Under those circumstances, it is generally most efficient to recover the revenue shortfall through a value-based fee.

Variable Cost Recovery. In a competitive market, a firm finds it profitable to expand output so long as price exceeds marginal cost, which is the cost of an additional unit of output. Marginal costs, however, are notoriously difficult to calculate. In the short run, capacity is fixed, and marginal costs consist mostly of labor. Accordingly, average variable cost has generally been accepted as a reasonable proxy, and it serves that function under the proposed pricing scheme.[34]

Fixed Cost Recovery. By definition, price equal to average variable cost does not recover the fixed costs of providing a service. While it would be inefficient to charge less than average variable cost, short-run efficiency does not require the recovery of fixed costs. Fixed costs are incurred regardless of use, and it would be inefficient to discourage demand during periods of excess capacity by burdening some users with an unnecessarily large share of those costs. Two factors – economies of scale and demand fluctuations – are important in determining how these fixed costs should be recovered.

First consider the case where the service is produced subject to constant returns to scale. With constant returns to scale, the size of the facility can be matched with peak period demand. Capacity will be expanded so long as peak users place a sufficiently high value on the added capacity to finance the requisite investment. In the presence of constant returns to scale, therefore, price could vary over time as it balances demand with capacity. All users operating during periods in which there was no excess capacity would bear the fixed costs of the facility, although users during periods of higher demand would pay more. In other words, the charges to recover fixed costs would be established with the goal of reducing variations in demand over time. In no case, however, would a user pay less than average variable cost and the total revenues would not exceed the costs of operating the facility.

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[33] The output that equilibrates price and marginal cost is efficient, because it would be inefficient to produce either more or less. If too much were produced, users place a lower value on the added output than its cost of production, and thus consumers are unwilling to pay the cost of the extra unit of production. Price above incremental cost is also inefficient, because users place a higher value on additional output than its cost to product, and accordingly output should be expanded.

[34] See, for example, Phillip Areeda and Donald Turner, "Predatory Prices and Related Practices Under Section 2 of the Sherman Act," *Harvard Law Review*, Volume 86, 1975, pp. 697–733.

In the presence of economies of scale, a different cost recovery system may be required. Indivisibilities may necessitate investing in too much capacity at any given time.[35] As a result, excess capacity may be present even during periods of high demand. In that case, fixed cost recovery would require at least some users to pay more than marginal cost. It has long been recognized that the most efficient method of recovering fixed costs in the presence of excess capacity is through Ramsey prices.[36] Ramsey prices allocate fixed costs among users based on their elasticities of demand – those with less elastic demand contribute a disproportionately large share toward the fixed costs. The lower a purchaser's elasticity of demand, the smaller the impact a given percentage change in price will have on the amount purchased. Accordingly, Ramsey prices are efficient, because they recover the fixed costs and produce the smallest deviation from the output produced by marginal cost prices.

A strict implementation of Ramsey prices is technically not possible, because price elasticities of individual purchasers are not observable. As an alternative, variations in prices among purchasers would be based on some proxy The greater the value a consumer attaches to a good or service, the smaller the impact a given percentage change in price has on the quantity demanded. As previously noted, many of the present aviation taxes and fees are value based. The proposed pricing scheme employs aircraft weight and aircraft weight minutes (i.e., an aircraft weighing a thousand pounds flying for 100 miles minutes generates 100,000 aircraft weight minutes) to measure value. The value of a flight is related to its payload, which in turn is likely to be highly correlated with the size of the aircraft. Similarly, longer flights tend to be more valuable.[37] Aircraft weight is an equitable and transparent measure of value, because the relationship between aircraft weight and capacity exists regardless of what the flight transports or whether it is a commercial or private service.[38]

4.1.2 Responsive to Changes in Costs and Demand

An added flight during a congested period may significantly degrade the service quality of others. Yet the degradation in service quality reduces demand. A higher price, therefore, might not only be profitable, but could also actually improve the quality of service. (In fact, because of the improved service quality, the higher price would actually increase demand.) Because users would be charged more during periods where congestion resulted in consistent delays, the price at any time depends not only on the costs at the facility but on demand as well.

With demand and capacity held constant, prices would be changed periodically to reflect changes in costs of producing the service – a 10 per cent increase in cost would produce a 10 per cent price increase. If, however, increased demand produced increased

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[35] An investment in too much capacity may be prudent in anticipation of future growth or to employ a lower cost technology.

[36] Viscusi, et. al., op.cit., pp. 365–367.

[37] Time is a more accurate measure of value than distance, because the cost per mile of an aircraft's operation is lowest when the aircraft reaches cruising altitude.

[38] This relationship is not exact. Newer aircraft use lighter materials and are therefore can carry greater payloads per unit of aircraft weight. In fact, a whole new class of very light jets, which are expected to be widely employed as air taxis, should begin operating in 2006.

congestion during a particular period, a larger price increase during that period might be appropriate. Specifically, the price for peak period users would be established sufficiently above average variable cost to limit the delay faced by users of the facility at the time. Because the total revenues generated by the fees cannot exceed cost, an increase in the price above the percentage change in cost at any given time requires a corresponding lower rate of increase during other periods. Determining the necessary adjustments to be made is not straightforward. There is uncertainty with respect to the effect of price changes on demand as well as their effect on revenues.

Increases in peak period fees would be dictated by delay statistics with higher fees generally associated with periods of time experiencing longer delay. Fees in adjacent periods may also need to be raised to limit the likelihood of congestion being shifted into those periods. For example, raising fees for flights between 5 and 5.30 p.m. may lead some users to simply shift their flights to a later or earlier time period. This may simply shift the congestion to a different period. While it might be appropriate to adjust adjacent period prices, a period with a higher fee should not have fewer delays than a period with a lower fee.

4.1.3 Airports and ATC Offer Complementary Service

A flight uses both airport and airways services, and a change in the price of one of the services increases the demand for the other. An increase in an airport's peak period fees would affect the timing and the mix of aircraft using ATC services as well. The relationship is especially close in the case of airports and terminal operations, because aircraft employ both in fixed proportions.[39]

Suppose, for example, an airport experiencing congestion moved to a cost-based movement fee for the use of the airfield. Independently adjusting terminal operations to reflect congestion could produce prices too high and as a result generate excess capacity during peak demand periods. Because the use of airports and ATC services are so closely related, the prices for the services of airports and the ATC should be established in conjunction with one another.

4.2 The Economics and the Politics of Airport Delay

A number of economists consider delay at a congested airport to be the result of a market failure – users do not pay the costs associated with the increased delays that is associated with an additional flight at the airport. Advocacy of congestion pricing began in the mid-1960s in response to a significant increase in delays at a number of airports, and the view among some economists that the problem could be best viewed as an externality. These congestion problems were ultimately resolved with Congress limiting aircraft operations at five airports. Congestion has been a recurring problem, even as restrictions at those airports are actually being relaxed. The government has been exploring alternative methods of controlling access including a "market solution", which is a euphemism for congestion pricing.

[39] Flights use the services of terminal control and the airfield in fixed proportions – much like the sale of left and right shoes. Unlike shoe manufacturing, however, the same firm does not produce both terminal control and airfield services, and it would be sensible if the entities coordinated the price-setting process.

Delay can be considered an externality because the transaction between a flight operator and, for example, the airport, can affect other operators. Establishing a congestion fee to reflect the delay costs imposed on others would more closely align the price a user had to pay for a service with the full social cost of the service. Increasing the costs of operating during congested periods, such a fee discourages those flights that place a relatively low value of operating at the facility during peak periods. This is economically efficient because a well-functioning market allocates a scarce resource to those valuing it most highly. Thus, even if the congestion fee were established to maintain existing levels of delay, the change in the flight mix at the airport could yield welfare gains. A higher price would reduce delay and could thereby yield even further gains.[40] Explicitly incorporating demand into the establishment of prices would yield similar welfare gains at a lower overall cost to users.

By charging a higher price, a so-called congestion fee would internalize the externality. While delay is an externality, it is not a natural outcome of producing airport and airways services. As already noted, the present pricing system actually subsidizes system use during high demand periods. In other words, delay is at least partly the peculiar pricing system established by the political process. Users fear that the imposition of congestion prices will increase carrier costs with no assurance of a corresponding improvement in service quality.

Congestion fees increase the cost of all the flights operating during peak periods – high-value and low-value flights would both pay higher fees in order to encourage the low-value flights to move to either less congested time periods or different airports. Yet the existing pricing system actually subsidizes these low-valued flights. Thus the imposition of congestion prices would require high-value flights to continue to subsidize airport and airways services received by these low-value flights, and then pay yet another fee as part of an effort to encourage these subsidized flights to operate differently. When combined with the present pricing system, a congestion fee would require high-value flights to pay twice – an above cost fee to subsidize low-value flights and then a congestion fee to undo the effect of the subsidy. Clearly, it would be far more efficient to align prices more closely with cost before even considering imposing congestion fees.

Not only may it be a mistake to classify delay as the product of an externality, recent economic research has suggested that, at least at some airports, delay may not even be a reliable indicator of market failure.[41] At many major airports, a hub carrier accounts for a large share of the operations. In order to minimize the time passengers must spend on the ground between flights, a hub carrier often bunches its arrivals and departures. An increase in the hub carrier's flights will increase delays at the airport, but it is the hub carrier's own flights that will experience most of the increased delay. Delays a carrier imposes on itself are not an externality. With hub carriers typically accounting for more than half of the flights at their hubs, delays at such airports should not be considered as the actions of two parties affecting a third.

[40] It would be both efficient and profitable for an airport to raise price in the face of congestion so long as the value of the resulting reduction in delay exceeds the additional revenue generated by the price increase.

[41] See, for example, Mayer and Sinai, op.cit.

The proposed pricing system is not congestion pricing per se, although it recognizes congestion as a factor in allocating the costs of the airport and airways system among system users. The higher prices during more congested periods do not reflect the costs of congestion as much as they provide a clearer signal of the value of the value of expanding a facility. Moreover, unlike congestion prices, the charges under the proposed scheme will not generate revenues in excess of the cost of the service provided.

5 DEFINING THE NEW SYSTEM

While representing a movement toward cost-based prices, the proposed price system nevertheless maintains important characteristics of the existing system. Most notably, the proposed pricing system generates revenues equal to the costs of providing the relevant services, and it maintains important attributes of the current system of value pricing. It, however, eliminates different prices for different types of users, and it establishes consistent pricing between airports and airways, which are complementary services.

Under the proposed system, a flight would be assessed charges for the airfield and for the terminal operations at the airport where the flight originates as well as at the flight's destination.[42] These charges would be established to recover specific and well-defined costs. In addition, no user would pay less than average variable cost, a proxy for marginal cost. During periods of congestion, however, this base fee would be increased in order to reduce delay at the facility. Flights operating at the airport would, therefore, pay the greater of average variable cost- or a congestion-based fee. If the revenues from these fees failed to generate revenues sufficient to cover the relevant costs, flights would also be assessed a weight-based fee to make up the shortfall.

5.1 Airports

In the hypothetical competitive market, an airport would charge all flights uniform fees with the specific fee at any time reflecting the level of congestion. During periods of low demand, at night for example, price would approach zero, because the marginal cost at airports is quite low. Because the levels of congestion may differ between the time an aircraft arrives at an airport and when it departs, it would likely be efficient to institute separate charges for landings and take-offs. In the subsequent discussion, such a charge is referred to as an airport use fee.

While efficient, the revenues generated by these congestion-based prices might be less than the operating cost for the airfield weight-based fees would recover the shortfall. At airports with substantial excess capacity, therefore, virtually the entire airfield costs would be recovered through a weight-based fee, which is precisely how landing fees

[42] As discussed in detail below, the airfield and the terminal operations fees will be constant over time. As a result, these airports can continue to charge a single fee to cover both landings and take-offs as is the case with the existing landing fees.

are currently established.[43] There are likely to be many such airports. Runways are not scalable: a runway built to handle one operation per hour can also accommodate up to 45 per hour, resulting in excess capacity for large portions of the day, and in some cases, the entire day.[44]

This two part charging system – a uniform fee based on congestion coupled with a weight-based fee to recover the shortfall – requires large aircraft operators to continue paying fees well in excess of the cost of service at airports with limited or no congestion. As noted earlier, however, weight-based fees are likely to be reasonable approximation of Ramsey prices, and therefore, a relatively efficient means of recovering fixed costs.

A shift to more cost-based prices generates an efficiency gain by providing some basis for quantifying the value of the expanded capacity. That portion of the airport use fee that is influenced by the level of congestion at the airport would be an important input into any analysis of the added value. Added capacity benefits peak period users. In a pricing environment with a minimum airfield use fee, additional airfield capacity would lower these minimum fees and encourage operations by lower valued flights. The decision to expand capacity should be based on whether the revenues generated by the additional flights would be sufficient to justify the added cost of expanding the facility. Decisions to expand capacity should not be based on the ability to recover the cost of the expansion from users that would be accommodated by the existing facilities if they were being priced efficiently. In other words, the ability to extract higher fees from heavier aircraft should not be considered in valuing capacity additions.

5.2 ATC Services

Under the proposed system, the two components of ATC services, terminal control and en route control, would be priced separately. Terminal control costs, like airfield costs, are very much influenced by take-offs and landings at a particular airport. En route control, on the other hand, is influenced by the amount of time a flight is airborne.

This analysis assumes ATC services are subject to constant returns to scale over a wide range of outputs, and unit costs of ATC services are uniform across the country. A cost pool for terminal operations at each airport, therefore, would be derived by applying a nationwide unit cost (e.g., cost per aircraft movement) to the expected activity at the airport.[45]

5.2.1 Terminal Control

Because the cost of terminal control is airport specific, the derivation of the price of terminal control is also airport specific. As in the case of airfield services, each flight (and each take-off and landing) is priced separately.

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[43] Weight-based landing fees are also justified by larger aircrafts' requirements for longer runways, greater reinforcement and wider taxiways.

[44] The capacity of the airfield, however, can be expanded by constructing more taxiways. By permitting aircraft to spend less time on the runway, an expansion increases the amount of time the runway can be used to for landings and take-offs.

[45] In practice it may be advisable to establish more disaggregated cost pools – for example, by metropolitan area or by a characteristic of the metropolitan area such as size.

All flights, regardless of when they operate, would pay at least average variable cost for terminal control.[46] Additions to airport capacity can sometimes be made in relatively large increments – a runway, for example, represents a significant increment to capacity. In contrast, terminal operations at an airport are much more likely to exhibit relatively constant returns to scale, and, as a result, the facilities needed to provide the appropriate level of services can be tailored to match demand. Because of the flexibility in determining the size of the terminal operations at an airport, there is less likely to be excess capacity, which also reduces the need to employ weight-based pricing to recover fixed costs.

Unlike airfields, therefore, value pricing would ultimately likely play only a very small role in the recovery of the costs of terminal operations. Nevertheless, because of the importance of value pricing under the current system, the continued use of value as a component in the pricing of terminal services may be warranted in any transition. Some aircraft operators may have made investments in equipment and other resources based on the existing system of charges. Continuing to have a significant – although over time diminishing – component of the terminal price based on value may soften the financial impact of the shift and make implementing a new pricing regime more politically palatable.

5.2.2 En route control

En route control provides ATC services between the arriving and departing airports. Unlike the space surrounding an airport, the space between airports is virtually limitless. In practice, aircraft are routed along defined traffic lanes, which effectively limit capacity at any given point in time. Yet because these traffic lanes are not made of brick and mortar, they are generally less a source of chronic congestion than either terminal control or the airports themselves. First, the FAA has some flexibility to determine the route of any given flight. In addition, over time, FAA has substantial flexibility to reconfigure these highways in the sky, and can add traffic lanes to meet demand growth. More significantly, the FAA is working on a system to increase a flight's flexibility in selecting its own course in moving between airports. Such "free flight" not only reduces travel times between airports, but it further diminishes the possibility of aircraft experiencing en route congestion.

The variable cost of providing en route control services to an aircraft depends directly on the length of time it travels between airports.[47] Identifying peak travel periods and assessing fixed charges is more difficult in the case of en route control than it is for terminal control. For example, simply defining a traffic peak would be challenging – different areas experience peak traffic at different times. Moreover, the use of a weight-based measure to recover fixed costs is unlikely to introduce significant distortions.

[46] Because unit costs of terminal control are the same at all airports, average variable costs are also the same. This assumes that average variable costs are constant over time. In fact, average variable cost may be lower during off-peak periods.

[47] During take-off and landing flights not only travel more slowly, but they also do not fly in a straight path because of the need to position themselves. After leaving terminal control, flights are nearing their cruising speeds, and thus the time for which a flight uses en route control is closely related to distance. The variable cost of operating en route control, therefore, can be allocated to a flight based on either the amount of time or the number of miles, although the relationship between mileage and cost would not necessarily be linear.

Nevertheless, such weight-based prices involve subsidizing low-valued flights, and this may be a problem at airports where congestion remains even after the imposition of cost-based prices for both the airfield and terminal operations. At such airports, therefore, it may be prudent to recover the fixed costs of en route control through prices that are tied to congestion.

6 EXAMPLE OF LAGUARDIA AIRPORT

There is substantial demand by aircraft to operate at New York's LaGuardia Airport. This airport, however, can only use one of its two intersecting runways at a time, and because it is surrounded by water and Queens, expansion is not a realistic option. Congestion has been a major problem at the airport for over 40 years, and the federal government has limited access to it since 1968, when it was one of a handful of airports governed by the High Density Rule (HDR). The HDR set hourly limits on the number of take-offs and landings at the airport, and it allocated operations among various different classes of carriers. The Congress has ordered an end to the use of the HDR at LaGuardia in 2007.[48] General aviation accounted for less than 4 per cent of operations at the airport in 2004, but there is considerable unmet demand by private aircraft. Even if private aircraft were subject to the same prices as other aircraft using the airport, their use of the airport would undoubtedly increase substantially. The following analysis assumes general aviation operations at LaGuardia would continue to be capped. Indeed, it is likely that even with the proposed pricing system, additional measures might be needed to limit congestion at the airport.

Despite the apparent great demand to serve LaGuardia, nearly half the passenger aircraft serving the airport in 2004 had 50 seats or less.[49] The proposed system would increase the amount these aircraft would pay more for the use of the airport and airway system, and thereby have an adverse effect on the profitability of flights using such equipment. In contrast, the cost of using larger aircraft would decline. The ultimate impact of the new pricing system, however, would depend on how carriers change their existing services as a result of these changes in profitability and the new services they introduce.[50]

The estimates in Tables 5–11 are based on services patterns at LaGuardia in 2004, and they provide a rough approximation of the costs and revenues of the various services offered at the airport. The calculations are merely illustrative. Most notably, no attempt

[48] In 2000, the Congress exempted regional jets from small and medium communities from the HDR. This relaxation of the rule produced a flood of new service and dramatically increased delays at the airport.

[49] These statistics are derived from DOT May 2004 T-100 statistics and exclude international flights. Passengers on international flights accounted for 5 per cent of the total at the airport during 2004. See Port Authority of New York and New Jersey, "December 2004 Passenger Report" (http://www.panynj.gov/).

[50] While carriers can and do sell their operating rights, it is unlikely that the current mix of flights represents the highest valued services that could be offered at the airport. By refusing to sell an operating right to a higher valued user, a carrier preserves its option to realign its schedule in the future while preventing a rival's introduction of a competitive service in the near term. Such strategic considerations may limit the ability of a free market in operating rights to result in an optimal pattern of service.

has been made to factor a flight's contribution to the carrier's network in developing the revenue estimates.[51]

6.1 Taxes Under the Existing System

To understand the impact of a new pricing system at LaGuardia, the revenues generated by the existing tax and fee system must first be estimated. To do this, flights are grouped into five categories based on aircraft size: the largest consists of aircraft with more than 120 seats, and the smallest has aircraft with fewer than 30 seats. Table 5 shows, the number of departures for each size category as well as averages of the number of seats, distance, and number of passengers. The three smallest size categories of aircraft, each with 50 seats or less, are operated by regional carriers. Though regional carriers are increasingly operating jets with more than 50 seats, these represented a very small proportion of the operations at LaGuardia in 2004. Thus, flights with more than 50 seats are assumed to have been operated by mainline carriers.

Estimating the taxes and fees for the average flight in each aircraft group requires information on both aircraft weight and average fare. To determine aircraft weight, a representative aircraft was selected for each size class.[52] The average fare for each aircraft was based on the statistical relationship between distance and local fares fare for all LaGuardia markets with nonstop service in the second quarter of 2004.[53] Table 6 provides an estimate of the revenues generated by the average flight of each of the five aircraft types as well as the taxes and fees such flights would pay. In computing revenues, a flight is assumed to carry the average number of passengers of its respective size class, with each passenger paying the average fare of local LaGuardia passengers traveling that distance. The ticket tax is 7.5 per cent times those revenues, and the segment fee is $3.10 times the number of passengers.

Table 5 LaGuardia Flights by Aircraft Size, May 2004

Aircraft Seats	Departures		Average Seats	Average Passengers	Average Minutes	Average Distance
	Number	Per cent				
120 and up	7,263	48.0	146.5	105.8	103.2	742.0
51–119	788	5.2	107.7	82.0	106.2	772.6
40–50	2,659	17.6	49.4	30.5	78.5	496.8
30–39	4,046	26.8	36.8	20.4	67.8	328.9
less than 30	364	2.4	19.6	9.1	52.1	178.7

Source: DOT, T-100.

[51] For example, the economics of a flight between New York and Boston with only local passengers is very different from a flight between the two cities where a significant proportion of the passengers are connecting transatlantic passengers.

[52] Maximum gross take-off weights were taken from the websites of the various manufacturers.

[53] This is likely to overstate the onboard yields because connecting passengers typically have lower yields than local passengers.

Table 6 Taxes and Fees Under Existing System, 2004

Aircraft	Landed Weight	Yield per Mile ($)	Landing Fees ($)	Aviation Taxes ($)	TOTAL ($)
A-320	145.5	0.216	578.36	1,599.79	2,178.15
B-717	102.0	0.208	405.45	1,241.98	1,647.43
ERJ-145	42.5	0.315	140.94	453.17	594.11
ERJ-135	40.8	0.464	135.10	296.58	431.68
Twin Otter	12.5	0.825	41.41	128.53	169.93

Source: Manufacturers websites and DOT *Origin and Destination Survey.*

Most airports assess landing fees for a flight's landing and its subsequent take-off, although this analysis assumes landings and take-offs are assessed separate airfield use fees. Because the landing fee at LaGuardia is relatively high, it is assumed that the mainline aircraft operate to airports where the appropriate fee is one-half as large, and the smaller aircraft operate at airports where the landing fee is one-fourth the fee at LaGuardia. This analysis does not specifically incorporate the taxes on fuel and cargo or the PFCs charged by most large airports. As already noted, these taxes and fees, like the ones considered here, are for mostly value based and including them would not fundamentally affect the analysis.

6.2 Cost of Service

Table 7 estimates the average cost of providing airport and airways system for the five hypothetical flights considered above. The average cost estimates use the ATC estimates derived in Section 3 and are movement based. Airfield use fees were derived by assuming the existing landing fees recover airfield costs. The existing difference in taxes and fees among aircraft is quite large. A flight in an A-320 flight pays fees that are more than 10 times the amount paid by the Twin Otter flight and three times the

Table 7 Average Cost of LaGuardia Flights, 2004

Aircraft	Terminal Control		Landing Fees		En Route Control ($)	Total Cost ($)
	LaGuardia ($)	Other ($)	LaGuardia ($)	Other ($)		
A-320	131	131	249	124	294	929
B-717	131	131	249	124	303	937
ERJ-145	131	131	249	62	224	796
ERJ-135	131	131	249	62	193	766
Twin Otter	131	131	249	62	149	721

Source: Author's calculation.

Table 8 Price–Cost Differential, 2004

Aircraft	Curmet Taxes and Fees ($)	Average Cost ($)	Difference ($)
A-320	2,178	929	1,249
B-717	1,647	937	710
ERJ-145	594	796	−202
ERJ-135	432	766	−334
Twin Otter	170	721	−551

Note: Aviation Taxes derived by assuming all passengers pay estimate of average local fare for the appropriate stage length.
Source: Authors calculation.

amount of a flight by a 50-seat EMB-145.[54] Because the costs of the airport and airway services are predominately movement based, these price differences are largely unrelated to differences in the cost of the services provided. Accordingly, the A-320 flight pays $1,240 more in taxes and fees than the average cost of the service it receives (Table 8). In contrast, the Twin Otter pays $551 less than its average cost of service, and even the average flight by 50-seat ERJ-145 pays significantly less in taxes than the average cost of the service it receives.

Table 9 compares the total taxes and fees generated by LaGuardia flights with the cost of the airport and airways services at the airport. These estimates assume that each of the five representative flights operates with the same frequency as the flights in its representative size class. For example, there are 18,912 operations of flights with between 50 and 120 seats, and these calculations assume there are an identical number of B-717 operations.

Table 9 Comparision of Revenues and Costs of Serving LaGuardia Domestic Passenger Flights, 2004

Aircraft	Current Revenues ($)	Average Cost ($)	Flights	Revenues from Taxes and Fees ($)	Cost of Services ($)
A-320	2,178	929	174,312	379,678	161,912
B-717	1,647	937	18,912	31,156	17,727
ERJ-145	594	796	63,816	37,914	50,800
ERJ-135	432	766	97,104	41,918	74,344
Twin Otter	170	721	8,736	1,485	6,299
TOTAL				492,150	311,082

Note: The number of flights is annualized from operations in May.
Source: T-100 and Table 8.

[54] Assuming aircraft at the other airport pay a lower airfield use fee does not have a substantial effect on the differential. If the Twin Otter operate at an airport with the same airfield use fee as the A-320 its taxes and fees would increase by $8. The taxes and fees of the EMB-145 would increase by $28.

Commercial passenger carriers at LaGuardia substantially exceed the cost of the airport and airways services they consume. The estimated discrepancy is entirely due to the aviation taxes, because the landing fees cover the airfield costs. The observed discrepancy may be partly the result of relatively high fares and correspondingly high-ticket tax revenues at LaGuardia.[55] The disparity, however, also reflects the disproportionate share of the ATC costs paid by passenger carriers and their passengers.

6.3 Imposing Cost-Based Fees

Consider a case in which it is assumed LaGuardia is uniformly congested through its operating hours. As shown above, smaller aircraft pay well below the average cost of the services they receive, while the larger aircraft pay well above. Under the proposed system, each flight would pay the sum of a minimum airfield use fee consistent with some acceptable level of congestion and, if needed, a weight-based airfield fee assessed on all flights to cover any revenue shortfall.

As Table 10 shows, while the Twin Otter would face a substantial increase in landing fees, the increase to other aircraft would be more moderate. Given the pent-up demand for service at LaGuardia, the imposition of a flat rate airport use fee may not be sufficient to moderate delay. In the case of LaGuardia, however, a uniform movement-based airfield use fee may not be sufficient to solve the congestion problem. At other airports, however, shifting to a weight-based movement fee during congested periods would likely have a significant salutary effect.

Table 11 shows the total taxes and fees paid by the LaGuardia flights if the fees for both airfield use and terminal operations were set at average costs. This analysis assumes the other airports are not congested, and they charge weight-based airfield use fees. It is also assumed the flights pay average variable cost both for terminal operations at the other airport as well as for en route control. The fixed costs of these two components

Table 10 Impact of Instituting Average Cost Airfield Use Fees LaGuardia Airport, 2004

Aircraft	Average Cost Fee ($)	Existing Fee ($)	Change in Fee ($)	Flight Revenues ($)	Change as Per cent of Flight Revenues (%)
A-320	249	386	−137	16,956	−0.8
B-717	249	270	−21	13,170	−0.2
ERJ-145	249	113	136	4,780	2.8
ERJ-135	249	108	141	3,112	4.5
Twin Otter	249	33	216	1,338	16.1

Note: Existing fees are one-half of existing landing fees.
Source: Author's calculations.

[55] If the same relationship between distance and yields existed at LaGuardia as it does at other major cities, the LaGuardia flights would have generated 15.7 per cent less revenue. This analysis is based on markets with nonstop service, and like the LaGuardia fares does not reflect the lower yields of connecting passengers.

Table 11 Impact of New Fees on LaGuardia Flights, 2004

Aircraft	New Fees ($)	Existing Fees ($)	Difference ($)	Flight Revenues ($)	Change as Per cent of Flight Revenues (%)
A-320	929	2,178	−1,249	16,956	−7.4
B-717	937	1,647	−710	13,170	−5.4
ERJ-145	796	594	202	4,780	4.2
ERJ-135	766	432	334	3,112	10.7
Twin Otter	721	170	551	1,338	41.2

Source: Author's calculations.

of ATC services, however, are value priced.[56] Under this scenario, and assuming fares remained the same, the taxes and fees paid by the A-320 would decline by $1,249, while the taxes and fees paid by the 50-seat ERJ-145 would increase by $202. The increases would be substantially greater for the smaller aircraft.[57] These cost estimates assume no congestion at the other airport. If there were congestion at those airports, however, the impact on the smaller aircraft would be somewhat greater.

Aircraft with fewer than 40 seats account for 29 per cent of LaGuardia operations. The increase in taxes and fees for the 37-seat ERJ-135 accounts for more than 10 per cent of the revenues of those flights. The average increase for the ERJ-145 is 4 per cent, which of course means a greater increase for half of those flights. The impact on profitability would be substantially greater. If the operating margin on the average flight were 15 per cent, then the profitability of the average flight would fall by more than a quarter, assuming fares remained constant.

The effect of an increase in costs on flight profitability also depends on the impact on revenues. Fares increasing in line with the higher costs would reduce the impact of the new pricing system on a flight's profitability. The price impact on revenue – and profitability – of the new set of prices depends on the forces of supply and demand, which are market specific. Compare, for example, two markets served with regional equipment. In a market served by a single carrier, the increase in the price of using the airport and airways system will be distributed between the carrier and its passengers based on the elasticities of supply and demand. If the elasticity of demand in the market were relatively low, the new price system would have a relatively small effect on flight profitability, because passengers would bear most of any cost increase.

The effect would be greatly magnified, if the regional equipment service were provided in competition with another carrier's mainline service. In contrast to flights provided in

[56] Using value prices for the fixed component is part of a transition process. Because terminal and en route control operations are likely to exhibit constant returns to scale, value pricing would not be efficient in the long run.

[57] In practice, the minimum fee might vary over time, and the impact of the new system may be greater on some flights during those periods. This would most likely be the case when the peak demand on a route fails to match the peak demand for the airport overall.

regional equipment, the switch to cost-based prices would actually reduce the costs of operating mainline equipment on a route. The lower costs could put downward pressure on fares in the market, in which case the flight using regional equipment would be hard pressed to recover of any of the added cost from the new tax and fee system. If the carrier offering the regional service needed to reduce its fares to remain competitive, it would be effectively absorbing more than 100 per cent of the higher fee.

7 CONCLUSION

The current system for pricing the airport and airways system certainly contributes to the strains associated with its operation. The system subsidizes low-valued operations when congestion is a problem and suppresses use of price to signal the value of capacity additions. Indeed, a cursory review of the existing set of prices reveals a complex web of subsidies and cross-subsidies, which impose substantial costs but have no clear public policy objective.

The present system should be replaced. This chapter has advocated requiring all flights to pay at least the marginal cost of the service it receives, with that minimum price increasing as warranted by congestion. In no case, however, would the prices be permitted to generate revenues in excess of the cost of the service. On the other hand, any revenue shortfall would be recovered through a weight-based fee. The new fee system, therefore, encourages efficient operation while maintaining an element of value pricing, a cornerstone of the existing prices for use of the airport and airways system.

While this proposal represents a significant improvement over the current system, a number of factors complicate its adoption. While this analysis has focused on the subsidies presently received by regional aircraft, the existing system provides even greater subsidies to general aviation jet operations. Moreover, a switch to the new system could both put upward pressure on small community airfares as well as discouraging some service. This would likely generate significant political opposition.

Because the airport and airways system is both operated and regulated by government agencies decisions concerning pricing and output decisions are fundamentally political ones. A move to a more rational pricing system might therefore require compromise. Crafting a political solution would involve a continuation of at least some of the existing subsidies. Continuing those subsidies in their current form, however, would be counter-productive. Most notably, there should be a concerted effort to limit subsidies during periods of congestion. Moreover, any subsidies that are provided should be carefully targeted, and they should be discounts off the normal prices.

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