Massport's Program for Airport Capacity Efficiency

Comments of the Bureaus of Economics, Competition, and Consumer Protection of the Federal Trade Commission[1]

Washington, D.C.

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I. Introduction and Summary

A. Interest and Experience of the Federal Trade Commission Staff

The staff of the Federal Trade Commission ("FTC staff") is pleased to respond to Massport's invitation to comment on its Proposal for Airport Capacity Efficiency ("PACE"). The FTC staff has a longstanding interest in aviation issues, including the pricing of landings at airports. FTC staff research has led to the publication of a report on slot allocation, and a report on airline deregulation.[2] In addition, FTC staff has participated in several administrative proceedings involving airport access.[3] These

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[1] These comments represent the views of the Federal Trade Commission staff, and do not necessarily represent the views of the Commission or of any individual Commissioner. The Commission has, however, voted to authorize the Bureaus to submit these comments.

[2] D. Koran and J. Ogur, Airport Access Problems: Lessons Learned from Slot Regulation by the FAA, Staff Report to the Federal Trade Commission, May 1983; and J. Ogur, C. Wagner, and M. Vita, The Deregulated Airline Industry: A Review of the Evidence, Staff Report to the Federal Trade Commission, January 1988.

[3] For example, the FTC staff filed comments in Slots Transfer Methods, Before the Federal Aviation Administration ("FAA"), Docket No. 24105, August 1984; Elimination of Airport Delays, Before the FAA, Docket No. 24206, 1984; Slot Allocation Alternative Methods, Before the FAA, Docket No. 24110, 1984; Discussion Authority for Agreement to Shift Schedules, Before the U.S. Department of Transportation, Docket No. 44634, February 23, 1987; and Charges for the Use of Metropolitan Washington Airports,

proceedings raised issues that are similar to the issues addressed by Massport in PACE.

Although the benefits of airline deregulation are substantial, these benefits could be even larger if airports priced landings more efficiently. Research shows that deregulation has provided billions of dollars of benefits to society.[4] However, the price of a landing does not reflect its full costs, leading to excessive delays and reduced consumer benefits.[5] Current pricing of landings is inefficient because it wastes resources, such as extra fuel used by aircraft waiting to take off or land, and wastes the time of delayed passengers. Efficient pricing of landings would bring the benefits of deregulation closer to their potential.

We believe that PACE would be a significant step toward more efficient pricing of airport services at Logan International Airport (Logan). PACE recognizes that the cost of providing a landing varies with factors other than aircraft weight. In particular, the proposal recognizes that a landing during the congested morning or afternoon peak period may impose greater social costs than does a landing during an uncongested off-peak hour.[6] Hence, PACE contains proposals to make a portion of the landing fee

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Before the FAA, Docket No. 25204, April 13, 1987.

[4] The benefits, which have been estimated at $15 billion per year, result primarily because carriers are now able to set prices and schedules that reflect what consumers want and the cost of providing it (see S. Morrison and C. Winston, <u>The Economics of Airline Deregulation</u>, Brookings, 1986; and Ogur, Wagner, and Vita, 1988, Section II).

[5] See Morrison and Winston (1986) for a discussion of these inefficiencies.

[6] The social costs of a landing are the costs to society, including the costs to the airport, to aircraft operators, to passengers, and to residents living near the airport.

independent of weight. Some of those proposals would make that portion variable by time of day.

In the Appendix to these comments, we use Massport's assumptions to derive sample estimates of the benefits and costs of the agency's proposed pricing changes. Based on Massport's assumptions, making a portion of the landing fee independent of weight would yield benefits that are greater than costs.

We also offer suggestions that may further increase the net benefits of PACE. In particular, we suggest that Massport consider adjustments to the PACE landing fees so that they more closely approximate the added cost of an additional landing.[7] Such landing fees will generate the greatest net social benefits.

Finally, we offer for discussion a system of priority and postponable service as an alternative to restricting the number of landings below airport capacity. This approach would avoid restricting flights in good weather and, unless administrative costs were prohibitive, would increase net benefits.

B. The Program

In PACE, Massport proposes to change the basis on which it calculates landing fees at Logan.[8] Current fees, which are based on aircraft weight, are $1.31/thousand pounds (1,000 lbs.), with a minimum of $25 per landing. To generate the same revenues, Massport offers several alternative pricing

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[7] In economic terms, this is the marginal cost of a landing. As we will discuss below, marginal cost includes the resource costs imposed on the airport, the delay costs imposed on passengers, and the noise costs imposed on nearby residents.

[8] There is no takeoff fee at Logan, nor is one proposed in PACE.

schemes. Under one, Massport would charge a two-part price of \$91 + \$0.45/1,000 lbs. (PACE, pp. 22-23). This proposal would make a portion of the landing fee (\$91) fixed for all types of aircraft, and thus independent of aircraft weight. The fixed portion of the landing fee would be the same for all hours of the day. In the Appendix, we present sample estimates of the benefits and costs of this proposal.

Massport also presents several alternative proposals. One alternative pricing scheme would charge \$91 + \$0.72/1,000 lbs. during peak periods, and \$50 + \$0.72/1,000 lbs. during non-peak periods (PACE, pp. 27-28). Another alternative scheme would charge \$300 + \$0.45/1,000 lbs. during peak periods, and only \$0.45/1,000 lbs. during non-peak periods (PACE, p. 31). In these two proposals, the portion of the landing fee that is independent of aircraft weight would vary by time of day, being greater during peak hours than during off-peak hours. In addition, Massport proposes an alternative allocation scheme that would give large aircraft priority for 85 percent of the operations (takeoffs and landings) during peak periods. Rights to the remaining operations would be auctioned to small aircraft and essential service (PACE, Exhibit M). Finally, Massport proposes to assess general-aviation operations a fee of \$65 for each use of the general-aviation terminal at Logan (PACE, p. 21). Where available information permits, we will draw qualitative conclusions regarding the benefits and costs of these alternative proposals.

C. Estimated Benefits and Costs

In the Appendix, we provide sample calculations of benefit and cost estimates. Our calculations are based in large part on the data and assumptions provided in PACE. As a result, our calculations are dependent on the accuracy of that information. Where we have made additional assumptions ourselves, we have chosen conservative assumptions in order to understate the net benefits of the proposed pricing change. We should emphasize, however, that these figures are simply sample estimates drawn from the available information.

D. Priority and Postponable Service

As we understand the PACE proposals, they would restrict the number of landings on days with good weather, even though it appears that Logan can provide the current level of landings without excessive delays.[9] We offer for discussion a system that would restrict landings only on days with bad weather.[10]

II. Landing Fees and Economic Efficiency

Based on Massport's assumptions, we estimate that changing from the current fee of $1.31 per thousand pounds of aircraft weight to the proposed fee of $91 per landing plus $0.45 per thousand pounds of weight would increase net social benefits. We also estimate that offering priority and postponable service would further increase net social benefits.

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[9] That is, when visual-flight-rule (VFR) conditions prevail.

[10] That is, when instrument-flight-rule (IFR-1 or worse) conditions prevail. We recognize that the FAA and other airports would have important roles to play in any system of priority and postponable service. In principle, a scheme to offer such service could also apply to days when wind conditions reduce Logan's capacity below the level of demand.

Net social benefits would be maximized by a landing fee equal to the added cost of providing an additional landing in each time period.[11] Although part of the added cost varies with aircraft weight, another part of that cost is incurred because the landing takes place, preventing other aircraft from using the runway at that time. The part of the added cost that is unrelated to weight varies with the amount of congestion at different times of the day. Hence, economically efficient landing fees vary with the time of day in addition to varying with aircraft weight, unless any administrative costs incurred in implementing the time-sensitive fees would exceed the benefits obtained.[12]

A. The Added Cost of A Landing

The added cost of a landing includes: 1) the resource costs imposed on the airport, 2) the delay costs imposed on aircraft operators and passengers, including the delay costs imposed on other flights, and 3) the noise costs imposed on residents living near the airport. Economically efficient landing fees cover all of these costs.

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[11] For a discussion of the benefits of setting price equal to the added cost of service (marginal-cost pricing) see E. Mansfield, Economics, Fifth Edition, 1986, Chap. 25.

[12] Massport's current use of aircraft weight as the sole basis for landing fees is similar to the practice in airports around the world (see A. Walters, "Airports -- An Economic Survey," Journal of Transport Economics and Policy, May 1978, pp. 125-160). Some deviation from marginal-cost pricing may be justified at airports that have excess capacity and that must cover their costs from revenues (see S. Morrison, "The Structure of Landing Fees at Uncongested Airports," Journal of Transport Economics and Policy, May 1982, pp. 151-159). According to Massport, excess capacity existed at Logan for a period following deregulation (PACE, p. 14), but no longer does during peak periods under IFR-1 or worse conditions. Moreover, Morrison (1982) shows that, even if excess capacity still existed at Logan, landing fees based solely on weight would be inefficient.

1) **Airport Resource Costs**

Massport incurs added resource costs to provide a landing during both peak and off-peak periods. These costs are generally broken down into costs of maintenance, operations, and administration.[13] Aircraft weight is significantly related to such costs,[14] and so efficient landing fees should vary with aircraft weight.

2) **Delay Costs**

Under Massport's current landing fees, operators of and passengers on peak-period flights incur significant costs in the form of lost time due to delays.[15] Delay costs are imposed because one aircraft on a runway precludes runway use by other aircraft at the same time.[16] All types of

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[13] S. Morrison, "Estimation of Long-Run Prices and Investment Levels for Airport Runways," Research in Transportation Economics, 1983, pp. 103-130.

[14] The added cost of maintenance, operations, and administration is bigger for heavy aircraft than for light aircraft. For the mid-1970s, Morrison (1983) estimated that the typical airport's added cost of maintenance, operations, and administration was approximately $12 for an air-carrier operation, but not significantly greater than zero for a general-aviation operation. The author cited a study of British airports that obtained similar results.

[15] Off-peak operations incur delay costs that are significantly lower than the costs incurred by peak-period operations. Delay costs have been estimated by A. Carlin and R. Park, "Marginal Cost Pricing of Airport Runway Capacity," American Economic Review, June 1970, pp. 310-319; J. Likens, "The Welfare Costs of Nonoptimal Airport Utilization," Journal of Public Economics, 1976, pp. 81-102; S. Morrison (1983); and J. Yance, "Airline Demand for Use of An Airport and Airport Rents," Transportation Research, December 1971, pp. 267-281. Using the delay estimates of Flight Transportation Associates (PACE, p. 15) and estimates of the value of passengers' time, it may be possible to obtain estimates of marginal delay cost and the optimal congestion charge. Marginal delay cost is the cost of added delay imposed on passengers by an added flight.

[16] The current fee structure at Logan does not take into account the delay costs that a peak-period aircraft operation imposes on other aircraft operators and their passengers. Hence, too many flights are offered during peak periods, and delays are too long.

aircraft impose delay costs when they land during a peak period. Although these costs may be related to aircraft weight, current weight-based landing fees overstate that relationship, charging large aircraft too much and small aircraft too little.[17] Efficient landing fees include the delay costs that each aircraft imposes, a portion of which is unrelated to aircraft weight.[18]

Charging higher peak-period landing fees will cause some aircraft operators to shift peak-period flights to other times or other airports, thereby reducing the length of delays experienced by passengers and aircraft operators who continue to land during peak periods. Those passengers and operators who are willing to pay the higher fees are the ones to whom a landing at such times is worth the most. Also, charging lower fees during off-peak periods will benefit those operators and passengers who are flexible enough to shift landings to off-peak periods.

As noted above, two of Massport's alternative proposals would vary landing fees by time of day. Such variation attempts to reflect the higher

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[17] Walters (1978, p. 133) notes that larger aircraft require greater spacing because of the increased turbulence that they generate. The author also notes, however, that existing weight-based landing fees overstate the resulting added costs of handling such aircraft.

[18] Landing fees that attempt to recover the historical costs of the airport can lead to distortions that increase delays. First, the historical costs of older airport facilities tend to be lower because of depreciation and because price levels were lower when those facilities were constructed. Thus, landing fees based on historical costs tend to be lower than efficient fees. Second, for any given level of historical costs, congested airports have more landings across which to spread those costs than do uncongested airports. Hence, landing fees based on historical costs tend to be lower at congested airports than at uncongested airports (Walters, 1978, p. 134). Finally, some airports, regardless of how busy, underprice landings because historical costs are covered primarily by revenue from concessions, such as restaurants and car-rental agencies (Office of Technology Assessment, 1984, p. 131).

delay costs of providing a peak-period landing than an off-peak landing.[19] Like other services offered at different times of the day with different costs to consumers, peak and off-peak landings are different services, and economic efficiency would require that consumers be charged different prices for such services.[20]

3) Noise Costs to Nearby Residents

Aircraft noise imposed on residents located near an airport such as Logan makes their houses less desirable. Massport is committed to keep cumulative noise impact at or below 1984 levels (PACE, p. 37). To implement this commitment efficiently, Massport could vary landing fees based on the noisiness of aircraft. Thus, noisy aircraft would pay a higher noise charge than would quiet aircraft. The charges, which would encourage the substitution of quieter for noisier aircraft, could be set so that Massport achieved its target of 1984 noise levels.[21]

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[19] Likens' (1976) results indicate that takeoffs also impose delay costs that vary by time of day. This result suggests that Massport consider charging takeoff fees that vary by time of day, provided that the added administrative costs do not outweigh the added benefits.

[20] A peak-period landing is higher cost than an off-peak landing in the same way that that an overnight stay in a hotel room is higher cost on a business day than on a weekend, and that a telephone call during business hours is higher cost than a call at night.

To reflect higher congestion costs, hotels charge higher prices for rooms on business days than on weekends; and telephone companies charge higher rates for calls during business hours than for nighttime calls. Similarly, efficiency requires that airports charge more for landings during congested peak periods than during less-congested off-peak periods.

[21] We make no judgment regarding the efficiency of these levels. The calculation of efficient noise charges is discussed in Walters (1978) and S. Borins, "Pricing and Investment in A Transportation Network: The Case of Toronto Airport," Canadian Journal of Economics, 1978, pp. 680-700.

B. Implementation of Efficiency Approach

Efficient landing fees should reflect all the costs of providing a landing, including costs imposed on the airport, on passengers and aircraft operators, and on nearby residents. Efficient peak-period landing fees would be higher than efficient off-peak fees primarily because the added delay costs to passengers and aircraft operators are higher during peak periods.

Some airports have taken steps toward efficient landing fees. London's Heathrow Airport has imposed peak-hour surcharges on all aircraft. Airports in the New York area have imposed such surcharges on general aviation. Massport imposed a minimum daily use fee for all aircraft, which was later discounted during off-peak periods. More recently, Massport discontinued these fees (PACE, pp. 25-26). Although the impact of these surcharges has not been rigorously estimated, the surcharges appear to have shifted flights to off-peak hours.[22] Such shifting may help avoid the need to expand airport capacity, at great expense, which might then be idle much of the day.

Efficient landing fees have been estimated for several airports, including Logan.[23] These estimates suggest that the peak-hour surcharges that have been imposed were smaller than efficient pricing would require. Nevertheless, the success of peak-hour surcharges indicates that Logan and other airports can proceed further toward efficient pricing, as have firms in

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[22] See Office of Technology Assessment, Airport System Development, August 1984, pp. 118-119 and 131-132); and PACE, p. 25-26. Although the number of peak-period flights increased at Heathrow two years after the peak-hour surcharges were imposed, this may simply reflect demand growth, which would increase the efficient surcharge.

[23] See, for example, Borins (1978) and S. Morrison, "Optimal Pricing and Investment Policies for Airport Landing Areas," Working Paper No. SL-7907, University of California, Berkeley, November 1979.

other industries, such as telecommunications, natural gas transmission and distribution, and electrical distribution.[24]

Efficient landing fees can also provide much needed information on the timing and location of airport expansion. As noted above, efficient landing fees include delay costs. The need for airport expansion can be judged by comparing the delay costs with existing capacity to the costs of building new capacity. Expansion should occur when the delay costs over the remaining life of existing capacity are expected to exceed the added cost of building new capacity. In that case, passengers and aircraft operators would save more in delay costs than the cost to society of the added capacity. By contrast, expansion would not be justified when the added capacity cost exceeds the expected delay costs.[25]

III. Benefit and Cost Estimates

To estimate the net benefits of Massport's proposed pricing change to $91 + $0.45/1,000 lbs., Massport should consider the approach we detail in the Appendix. Based on data provided in PACE by Massport, the proposed pricing change could save nearly 70,000 passengers more than 2,500 hours

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[24] Efficient fees are unlikely to shift the peak to a different time period because of the strong preference of business travelers for peak-period flights.

[25] The costs of added capacity might be met from the revenues raised by the landing fees, which in turn might be reflected in higher fares for peak-period flights. It should be noted that PACE does not address the financing of added capacity.

Logan now has four major runways (PACE, p. 12). However, we lack information on the current optimal number of runways at the airport. For the mid-1970's, Morrison (1983) estimated that the optimal number of runways at Logan was between three and five, depending on the interest rate and the value of passengers' time.

per day. To achieve these savings, approximately 67 general-aviation flights would be eliminated by the increase in landing fees.

Passengers on flights that continue to land at Logan after the price change receive benefits in the form of reduced delay time. Estimates of benefits should include this saving only when instrument-flight-rule (IFR-1 or worse) conditions prevail.[26] The value of the savings should equal the number of passengers on the flights that continue to land, multiplied by the amount of time saved per passenger and by a conservative estimate of those passengers' value of time.

Cost estimates should consist of the losses to passengers on cancelled general-aviation flights, flights whose operators are unwilling to pay the increased landing fees.[27] These are the losses stemming from cancelling these landings; that is, the amount that the operators would be willing to pay for the landings. The smallest amount that an operator is willing to pay is the original landing fee. The biggest amount that an operator is willing to pay is slightly less than the new landing fee. The total value of the

[26] We lack information on the extent of delays under VFR conditions. If delays are also reduced under these conditions, then the estimated benefits may be increased. However, it should be noted that total elimination of delays would not be efficient. To do so would eliminate landings that are worth more than the added time saved.

[27] This estimate is a substantial overstatement of the loss given the information provided by Massport. It should be noted, however, that Massport's estimates of the number of flights eliminated, and thus our estimates of the loss, do not take into account any effects of the proposed $65 fee for use of the general-aviation terminal. This fee is likely to eliminate more general-aviation flights and thus to increase both the loss and the benefits because delays would be further reduced. With available information, however, we are unable to estimate the net effect of this fee.

Given that Massport does not propose to increase total revenues generated by landing fees, our cost estimates equal the willingness of aircraft operators and passengers to pay for the foregone landings, minus what they actually pay, plus the increased landing fees that the remaining flights pay.

eliminated flights consists of the average of these two values, multiplied by the number of flights eliminated.

IV. Landing Fees that Vary By Time of Day

As an alternative to the landing fees considered above, which would be uniform across the hours of the day, Massport proposes to charge $91 + $0.72/1,000 lbs. during peak periods and $50 + $0.72/1,000 lbs. during off-peak periods. This alternative landing-fee schedule would raise the price of an off-peak landing less than the price of a peak-period landing. Although we would need additional information to estimate the net benefits of this pricing schedule, it may offer even greater net benefits than a uniform price during every hour of the day.[28] By eliminating fewer off-peak landings, time-variable pricing would impose smaller costs than would the proposal to charge $91 + $0.45/1,000 lbs. at all hours of the day.[29] The alternative proposal would also increase the likelihood that, in response to the pricing change, some general-aviation operators would shift their flights from peak to off-peak times at Logan instead of cancelling their flights or shifting them to another airport.[30]

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[28] In order to be most effective, peak hour pricing would also need to consider the time of takeoff. It is apparent that some of the benefits of peak hour pricing would be lost if planes landed during off-peak hours but departed during peak periods.

[29] A similar argument would apply to a takeoff fee.

[30] To the extent that the rescheduled flights increased delays during off-peak periods, then the estimated benefits of time-variable fees would be reduced somewhat compared to the uniform fee.

V. Priority and Postponable Service[31]

We offer for discussion a system of priority service at a higher price for Logan's IFR-1 capacity of 80 operations/hour, and postponable service at a lower price for the remaining capacity of 30 operations/hour under visual-flight-rule (VFR) conditions.[32] On IFR-1 days, Logan would first attempt to handle the priority operations at their scheduled times.[33] By contrast, the postponable flights would be delayed until an off-peak time when they could be accommodated without delaying a priority flight.[34]

A system with both priority and postponable service appears to have significant advantages over the current system in which all flights are postponable. Now, in the event of weather problems or mechanical problems

[31] We recognize that such a system would have to be implemented jointly by the FAA, Logan, and other airports. Nevertheless, we discuss the system in these comments because of its relevance to the net benefits of Massport's pricing proposals.

[32] In fact, under IFR conditions, Logan's capacity can vary substantially, depending on the runway configuration that can be used, from 56 operations per hour to 98 operations per hour (telephone interview with Massport staff). This variation suggests the plan might be modified to offer different degrees of priority for the different levels of capacity. This would clearly increase the complexity and administrative cost of the plan. Whether the added benefits would exceed the costs would have to be determined by careful analysis.

[33] We discuss priority service only with regard to weather conditions at Logan. We recognize, however, the relevance of weather conditions facing the air traffic control system and other airports. For example, a flight given priority at Logan could still be delayed because of weather elsewhere. Also, aircraft whose landings were postponed at Logan would have to remain at their origin airports, perhaps increasing congestion at those airports.

[34] Alternatively, operators whose flights were postponed in, for example, the first afternoon peak hour might purchase priority service in the second afternoon peak hour. This variant of our suggestion would make postponable service more attractive, but would also add to the complexity of the system. Whether the added benefits exceed the added costs would have to be determined by a careful examination of this and other alternative systems.

to one flight, all flights risk delay. There is no market in which aircraft operators can purchase priority service from airports and the air traffic control system. Both airlines and owners of general-aviation aircraft may be better off if they were offered a choice between such service at a higher price and postponable service at a lower price.[35]

A system of priority and postponable service would eliminate flights only under IFR-1 conditions or worse at Logan, which occur an average of one day in five. If such a system were added to the proposal to charge $91 + $0.45/1,000 lbs. at all hours of the day, the estimated cost would be reduced to one-fifth of the estimated cost of the price change by itself, which would eliminate flights every day.[36]

Implementing such a plan might cause aircraft operators to change their ticketing policies. For example, operators could respond to the higher price of priority service by charging higher fares, or by offering fewer discounted seats on priority flights. Operators could buy priority service for flights that carry passengers who place a high value on on-time service, such as business travelers, and postponable service for flights that carry passengers who place a lower value on on-time service, such as students. The latter

[35] Neither the current system nor any contemplated system can ensure that a flight will never be delayed. A system of priority service might, however, permit some flights to reduce the risk of a delay.

[36] If the postponable flights that were not cancelled caused the reduction in priority-flight delays to be somewhat smaller, then the benefits would also be somewhat reduced. With available information, we cannot evaluate this possibility.

might be willing to risk delay when the weather is bad to save money every time they fly.[37]

VI. Priority Peak Hour Fee Procedure

One of the alternative plans in PACE would group aircraft by size and give large aircraft priority for 85 percent of the flights during peak periods. Rights to the remaining flights would be auctioned to small aircraft and essential service (PACE, Exhibit M).[38]

Although we do not have sufficient information at this time to calculate the net benefits of such a plan, there is evidence that, in general, the use of auctions to allocate landings can yield substantial net benefits.[39] However, the benefits of this plan might be reduced because of the use of the 85-percent cutoff point. Net benefits may be increased if the auction is applied to all aircraft sizes.

Although aircraft size tends to be positively related to the net benefits of a flight to society, decreasing the number of small-aircraft landings by a

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[37] Although we do not know whether airlines would find it profitable to offer both priority and postponable service to their passengers, we suggest that such a system merits consideration as a possible solution to weather-related delay problems. FAA data indicate that weather causes approximately 70 percent of total delays (see Ogur, Wagner, and Vita, 1988, p. 34). One issue that would have to be carefully addressed in implementing such a scheme is how to handle flights that are en route when a change in the weather reduces the capacity of the system. In this regard, it is important to recall that all flights are postponable under the current system.

[38] PACE seeks to increase the average size of the aircraft that land at Logan in order to maximize passenger throughput (PACE, p. 20), subject to the constraint that revenues equal costs (PACE, p. 22).

[39] Studies of airport slot auctions are cited in Koran and Ogur, 1983, p. 6.

system that assigns them lower priority may lead to economically inefficient results, because some flights in small aircraft may have higher net benefits than some flights in larger aircraft. For example, the only morning-peak-period flight in a commuter aircraft between a small city and Logan may provide more net benefits to society than the fifth morning-peak-period flight, in a larger aircraft, between another, larger city and Logan. If so, the operator of the commuter aircraft may be willing to pay a high peak-period landing fee, but the operator of the larger aircraft may not.

Exclusion of a more beneficial flight may occur when the larger aircraft receives priority, but is carrying fewer passengers than the smaller aircraft, which does not receive priority (see PACE, Exhibit M). For example, some flights in a Beech 99 with fewer than 30 seats may carry more passengers and be willing to pay more for landings than some flights in a DC-3 with 30 seats (PACE, Exhibit H).[40]

VII. Conclusions

PACE appears to be a step toward economically efficient pricing of airport services that would provide significant benefits to aircraft operators and passengers. Based on Massport's assumptions regarding cost and demand conditions at Logan, it appears that the proposal to charge landing fees of $91 + $0.45/1,000 lbs. would yield benefits that are greater than its costs.

[40] An additional problem with this scheme is that it would limit the total number of operations to Logan's IFR-1 capacity of 80 operations per hour, even under VFR conditions (PACE, Exhibit M). This problem was examined above in our consideration of a scheme for priority and postponable service.

The alternative proposal to charge $91 + $0.72/1,000 lbs. on-peak and $50 + $0.72/1,000 lbs. off-peak may increase net benefits even further. Such a plan would probably eliminate fewer off-peak landings and would encourage peak-period general-aviation flights to shift to off-peak times instead of being cancelled or shifting to less-convenient airports.[41] Net benefits might be further increased if fees were set equal to the added cost of providing a landing. Finally, a system of priority and postponable service might also increase net benefits.

[41] We lack sufficient information to reach any conclusions regarding the effect on net benefits of the proposal to charge a $65 fee for the use of the general-aviation terminal and the proposal to charge $300 + $0.45/1,000 lbs. on the peak and only $0.45/1,000 lbs. off the peak.

APPENDIX

BENEFIT AND COST ESTIMATES: ASSUMPTIONS AND CALCULATIONS

Assumptions

With the information available in PACE, we can perform a sample estimation of the benefits and costs of Massport's proposal to change landing fees from $1.31/1,000 lbs., with a minimum of $25 per landing, to $91 + $0.45/1,000 lbs. To do this estimation, we will take as given Massport's description of cost and demand conditions at Logan.

On the cost side, the number of takeoffs and landings (operations) that Logan can supply depends on the weather at the airport.[42] Logan can supply 110 operations/hour under VFR conditions and ideal wind conditions. Logan can supply an average of 80 operations/hour under IFR conditions. Reduced capacity due to impaired visibility -- IFR-1 or worse -- occurs 20 percent of the time, on average. Unfavorable wind conditions cause additional capacity reductions (PACE, pp. 12-13).[43]

The demand for operations at Logan is subject to hourly and seasonal peaks and is projected to grow substantially. An hourly peak demand of approximately 100 operations/hour occurs at Logan during the morning and afternoon peak periods (PACE, pp. 13-14 and Exhibit E). August is the peak month for scheduled operations at Logan; March is the peak month for general aviation operations (PACE, Exhibit M). Projected increases in the

[42] Massport's estimates of Logan's ability to supply operations (capacity) assume that delays do not exceed the FAA's standard of 15 minutes per operation (telephone interview with Massport staff).

[43] Such unfavorable wind conditions occur an average of 2-3 percent of the time under VFR conditions (telephone interview with Massport staff).

demand for operations at Logan will cause peak-period demand to exceed VFR capacity within the next decade (PACE, pp. 14-15).

Thus, at prevailing fares and landing fees, peak-period demand exceeds Logan's capacity by approximately 20 operations/hour under IFR-1 conditions. As a result, approximately 7000 passengers/hour experience delays of approximately 20 minutes during the morning peak and 60 minutes during the afternoon peak. Massport considers delays greater than 15 minutes per operation to be unacceptable (PACE, pp. 15-16). Over the entire day, operations incur a total of 34,204 minutes of delay, or an average of 26 minutes per operation (PACE, Exhibit L).[44]

At Logan, air carriers conduct approximately 60 percent of the operations, carry 94 percent of the passengers, and use aircraft with an average capacity of 165 seats. Commuter airlines conduct 30 percent of the operations, carry 5 percent of the passengers, and use aircraft with an average capacity between 20 and 25 seats. General aviation conducts 10 percent of the operations and carries less than one percent of the passengers (PACE, pp. 18-19).

To estimate benefits and costs, we make use of Massport's assumptions and estimates. We adopt the assumption that the proposed pricing change will eliminate five percent of the operations in each hour, and that all of the eliminated operations will be by general-aviation aircraft (PACE, p. 29).[45] Thus, we assume that air carriers and commuters will not respond to

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[44] Exhibit L presents average delay per aircraft, which is equivalent to average delay per operation (telephone interview with Massport staff).

[45] We assume that the proposed pricing change will raise the minimum landing fee that is actually paid from $25 to approximately $100. This assumption is based on Massport's projection that the proposed change will increase the landing fees for a Beech 99 and a Beech 1900 to $95.54 and

the proposed change in landing fees by changing the number of operations demanded.[46] We also use Massport's estimate that the proposed change will reduce total delay time to 18,735 minutes, or an average of 15 minutes per operation, the level that Massport considers acceptable (PACE, Exhibit L). Thus, the proposed change will decrease the average delay by 11 minutes per operation.

The estimated benefits of the proposed pricing change equal the value of the time saved by passengers on the remaining flights. We make several assumptions that reduce these estimated benefits. First, we assume that

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$98.48, respectively.

[46] Air-carrier operations are likely to be less responsive to changes in landing fees than are general-aviation operations. First, landing fees are a relatively small fraction of the total operating costs of air-carrier flights. Also, air-carrier passengers to Boston appear to have no equally good alternative airports to Logan. Thus, in response to the decrease in landing fees that large aircraft would pay (see PACE, Exhibit J), it is reasonable as a first approximation to assume that air carriers will not increase their number of operations.

By contrast, landing fees are a larger fraction of the total operating costs of general-aviation flights. Also, general-aviation passengers appear to have both good alternative airports -- for example, Hanscom Field -- and good alternative carriers, the scheduled carriers (PACE, pp. 19-20). Thus, in response to the higher landing fees that small aircraft would pay, it is reasonable to assume that general aviation will reduce the number of its operations. Although we have less information on commuter carriers, their responsiveness probably lies somewhere between those of the other two groups.

At present we lack the information needed to estimate benefits and costs under the assumption that air carriers and commuters change the number of their operations in response to changes in landing fees. This assumption would probably be needed to estimate the benefits and costs of Massport's alternative proposal to charge $300 + $0.45/1,000 lbs. during peak periods and $0.45/1,000 lbs. during nonpeak periods. The additional needed information would include the number of flights and the distance of each flight by each aircraft type flown by air carriers and commuters. With this information, it might be possible to use estimates of the responsiveness of the carriers to landing fee changes to predict the change in the number of operations.

both air carriers and commuters operate with load factors of 50 percent.[47] Second, we assume that the general-aviation flights that remain despite the price increase carry an average of two passengers per flight.[48] Both of these assumptions probably lead us to understate the number of passengers whose delay time is reduced. Third, we value passengers' saved time at $5 per hour.[49] Finally, we omit any benefits to aircraft operators, who may benefit from decreased fuel costs and crew salaries because of reduced delays.

The estimated costs of the proposed pricing change equal the amount that operators are willing to pay for foregone landings, rather than cancelling these flights or diverting them to other times or other airports, minus the resources that would be used to provide the landings. We increase the estimated costs by assuming that no resources would be used to provide the landings.[50] We also assume that the operators' willingness to

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[47] In its calculations, Massport assumes a load factor of 70 percent for selected aircraft sizes (see PACE, Exhibit H).

[48] According to Massport, almost 7000 passengers per peak hour use Logan during peak periods, of which less than one percent are served by the 10 general-aviation flights per peak hour. These figures imply an average of fewer than seven passengers per general-aviation flight.

[49] A. DeVany ("The Revealed Value of Time in Air Travel," Review of Economics and Statistics, 1974, pp. 77-82) estimated the value of air passengers' time at $7.28 per hour in 1968. Adjusted for inflation, this would equal $20.37 in 1986 dollars. Also for 1968, Carlin and Park (1970) assumed values of $6 per hour for air-carrier passengers, and $12 per hour for general-aviation passengers. Morrison (1983) used values of time equal to $5, $10, and $15 per hour. By lowering fares and making air travel affordable to lower-income consumers, deregulation may have lowered air passengers' average value of time. Nevertheless, our $5 assumption is probably lower than the actual value of air travelers' time.

[50] For the mid-1970s, Morrison (1983) estimated that the typical airport's marginal cost of maintenance, operations, and administration was approximately $12 for an air carrier, but not significantly greater than zero for general aviation.

pay for landings is equal to the value of the flights to passengers minus the operating costs of the flights.[51]

Calculations[52]

Number of operations per day at current landing fees:

Total number of operations = total minutes of delay divided by average minutes of delay per operation

= (34,204 minutes)/(26 minutes/operation)

= 1,316 operations

Number of air-carrier operations = (0.6)(1,316 operations)

= 789 operations

Number of commuter operations = (0.3)(1,316 operations)

= 395 operations

Number of general-aviation operations = 1,316 operations - 789 operations - 395 operations

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[51] For each flight, the area below the demand curve for the flight and above the flight's operating cost is a measure of the economic concept of the consumer surplus that passengers receive from the flight. Consumer surplus equals the amount that consumers are willing to pay, rather than forgo the flight, minus the amount that they actually pay, which we assume equals the operating costs of the flight. For general-aviation flights, the operator's willingness to pay for a landing is a good approximation of the passengers' willingness to pay for the flight minus the operating costs of the flight. In the case of business, family, or single-person flights, there is only one decision maker, or decision-making group, whose willingness to pay is relevant. In the case of a group of unrelated individuals, small numbers facilitate a reasonably accurate determination of the combined willingness to pay. These conditions do not hold for the larger groups of passengers on commuter and air-carrier flights. See Yance (1971) and Koran and Ogur (1983) for an analysis of air carrier's demand for landings.

The measure that we use equals the entire area under ~~the~~ demand curve for landings, between the original quantity of landings and the reduced quantity after the price change (see R. Turvey, "How to Judge When Price Changes Will Improve Resource Allocation," Economic Journal, December 1974, pp. 825-832).

[52] The results presented in this section are affected slightly by rounding errors.

= 132 operations

Number of operations per day at proposed landing fees:

Total number of operations = total minutes of delay divided by average minutes of delay per operation

= (18,735 minutes)/(15 minutes/operation)

= 1,249 operations

Number of general-aviation operations = 1,249 operations - 789 operations- 395 operations

= 65 operations[53]

Number of passengers per day at proposed landing fees:

Number of air-carrier passengers = number of operations times number of seats per operation times load factor

= (789 operations)(165 seats/operation) (0.5 passengers/seat)

= 65,119

Number of commuter passengers = number of operations times number of seats per operation times load factor

= (395 operations)(22.5 seats/operation) (0.5 passengers/seat)

= 4,440

Number of general-aviation passengers = (65 operations)(2 passengers/operation)

= 130

Total number of passengers = 65,119 + 4,440 + 130

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[53] By assumption the number of air-carrier and commuter operations is unaffected by the change in landing fees.

= 69,689

Hours saved, benefits, and costs per day[54]:

Hours saved = frequency of IFR days times number of passengers times hours saved per passenger

= (0.2)(69,689 passengers)(11/60 hours/passenger)

= 2,555 hours

Benefits = hours saved times value of time per hour

= (2,555 hours)($5/hour)

= $12,776

Costs[55] = number of landings per operation times number of general-aviation operations eliminated times average value per operation

= (0.5 landings/operation)(67 operations){[($100+25)(0.5)]/operation}

= $2,079

Benefits/Costs = $12,776/$2,079

= 6.14

Benefits - Costs = $10,697

Hours saved and net benefits per year:[56]

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[54] Time saved and benefits are multiplied by 0.2 because they accrue only under IFR-1 or worse conditions, which occur an average of one day in five, or 20 percent of the time.

[55] The number of general-aviation operations eliminated was obtained by subtracting the total number of operations at the proposed landing fees, 1,249, from the total number of operations at the current landing fees, 1,316. The number of landings eliminated is obtained by multiplying the number of operations by (0.5) because there is one takeoff for each landing, and thus half as many landings as operations. Because landings are eliminated every day, costs are not multiplied by (0.2). As we noted above, Massport charges fees per landing, but not per takeoff.

[56] For these calculations, we assume that each flight is made on the 250 weekdays of the year. Seasonal variation in the extent of delays, due to weather and seasonal demand peaking, may affect net benefits. We lack the information needed to examine these possible effects.

Hours saved = (2,555 hours/day)(250 days/year)

= 638,817 hours

Benefits - Costs = ($10,697/day)(250 days/year)

= $2,674,253

Present discounted value of benefits - costs (PDV)[57]:

PDV = ($2,674,253)/(0.10)

= $26,742,533

[57] For this calculation, we assume that the benefits accrue in perpetuity and are discounted at 10 percent per year.