SECONDARY MARKETS &EFFICIENCY IN THE ALLOCATION OF SLOTS AT US AIRPORTS

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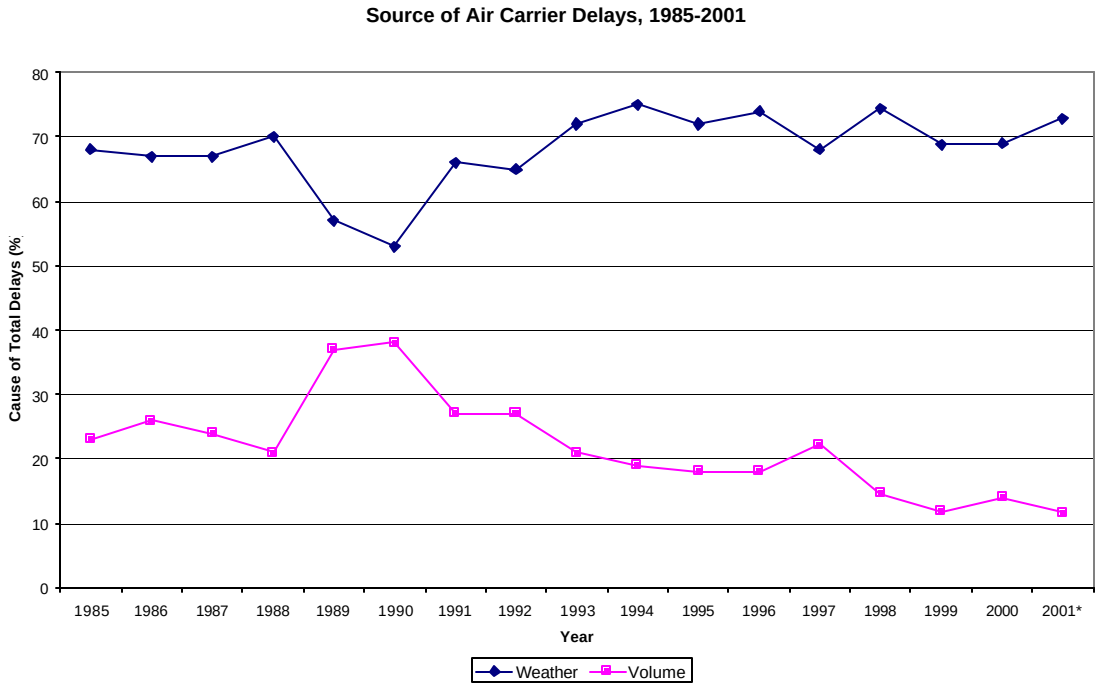
Introduction & Overview

1) Despite the fact that air travel has increased faster than US airport capacity for many years, congestion-related delay does not yet appear to be pervasive problem for the nation's aviation system. On the contrary, the vast majority of delays are caused by weather, not congestion, and thus, as explained below, are unlikely be ameliorated by the adoption of market based methods for allocating airport/runway access. As shown in the following exhibit based on data



Notes: Volume Delays include Airport Terminal Volume and Air Route Traffic Control Center Volume. 2001 data is for Jan-Aug.
Source: *Aviation Capacity Enhancement Plans*, U.S. DOT and FAA

compiled by the FAA, volume-related delays accounted for less than 15 percent of all delays in each of the 4 years preceding September 11, 2001, and the percentage of delays related to volume has declined over the past decade.

In contrast, weather-related delays accounted for between 2/3 and 3/4 of all delays over that same period.[2]

2) Nonetheless, there was a marked increase in delays (and a decrease in on-time arrivals) in 2000 that contributed to the perception of a delay "crisis." This increase, however, was due in large part to the increase in flights at New York's LaGuardia Airport (LGA) precipitated by the passage of legislation (known as "AIR-21") that removed the HDR's limits for flights operated by small commercial aircraft at LGA. Thus, in September of 2000 (i.e., immediately following the implementation of AIR-21), delays at LGA alone accounted for 25% of flight delays for the entire country.[3] Following the FAA's subsequent re-imposition of flight limits at LGA, delays both at LGA and nationwide fell significantly.

3) In addition, delays during the summer of 2000 were inflated as the result of a labor dispute involving pilots at United. This labor dispute caused a substantial increase in reported flight delays during the summer months of 2000 and resulted in delays of more than 15 minutes for 57.8% of United's arrivals during July of 2000. As a result, United alone accounted for 30% of all reported delays. Nearly a third (31.5%) of United's scheduled flights were late 70% or more of the time during July of 2000 compared to 0.5% for American and 0.2% for Delta during that same period, and 0.7% for United in July of

[2] Moreover, existing delays appear to be concentrated at only a handful of major airports. See *Operational Evolution Plan*, Version 3.0, U.S. Department of Transportation and Federal Aviation Administration, page 2.

[3] Source: *2001 Aviation Capacity Enhancement Plan*, U.S. DOT and FAA, page10.

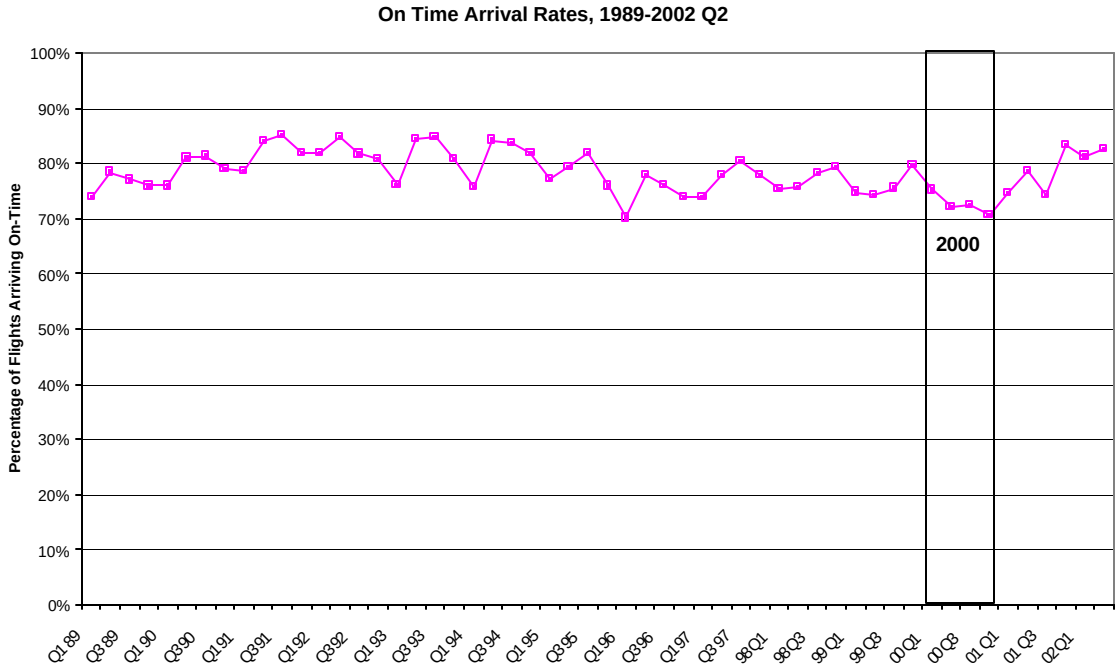
2001.[4] With the elimination of these significant (and non-recurring) events, the total number of delays declined substantially in 2001 – even prior to September 11th.[5]

4) As shown in the chart below, on-time arrival rates since at least 1989 have generally ranged between 75% and 85%. Except for the well-publicized delays of 2000 and notwithstanding the fact that the number of aircraft operations grew roughly 15% from 1989 to 2001,[6] on-time arrival rates have typically remained within that same range since 1989.

[4] Source: *Air Travel Consumer Reports*, Table 6, U.S. Department of Transportation.

[5] "[B]eginning in March 2001 the number of delays declined in every month except August. From April – June 2001, delays declined by 11.21 percent compared to the same period in the previous years. During June, July and August, when convective weather disrupts many operations, delays were down by 7.99 percent from the previous summer." Source: 2001 *Aviation Capacity Enhancement Plan,* U.S. DOT and FAA, page 17.

[6] Air carrier and commuter operations at airports with FAA traffic control service grew from 20.80 million in 1989 to 23.84 million in 2001. Source: *FAA Aerospace Forecasts.*



Notes: Flights are considered to arrive ontime if they arrive at their destination within 15 minutes of scheduled arrival time. Data for the 10 largest domestic carriers. Data for Q2, 2002 is for April and May.
Source: Air Travel Consumer Reports, Table 1A, Department of Transportation.

5) With the exception of the airports subject to the "high density rule" (HDR),[7] runway access at US airports has been allocated historically on a "first come, first served" basis.[8] Airport runway (and other airfield) costs are typically recovered via weight-based landing fees set at the level required to recoup the actual airfield costs incurred by the airport to provide, maintain and operate the airfield.

6) When available runway capacity is sufficient to accommodate all existing demand—as is typically the case at most U.S. commercial service airports—"first come, first served" is widely accepted as the least costly way of attaining an efficient allocation of runway resources. Thus, for the vast majority of U.S.

[7] Airports currently subject to the HDR are LaGuardia (LGA), Kennedy (JFK), and Reagan Washington National (DCA). O'Hare (ORD) was exempted from the HDR as of July 1, 2002.

airports, the prevailing "first come, first served" system remains the most efficient method for allocating runway access.

7) At a handful of high-demand commercial service airports in the United States, however, airport authorities have been unable or unwilling to add runway capacity to accommodate the increased demand.. As a result, unrestricted demand at those airports would – if not otherwise constrained -- regularly exceed available runway capacity thereby producing an economically inefficient level of congestion-related delays.

8) When demand for access to an airport exceeds the existing runway capacity for a significant period of time, however, it can lead to congestion-related delay. But not all congestion or delay is inefficient: As with any product, there is an efficient level of delay.[9] Congestion-related delay becomes an economic problem when the full "social" costs imposed by the use of a congested runway (including delays imposed on other aircraft and passengers) exceed the private costs (i.e., the costs borne by those seeking to use the runways when they are congested).[10]

9) Since adopting and implementing measures to reduce delays would be costly, the elimination of some delays is not economically worthwhile-- i.e., users would be willing to tolerate such delays when that would be less costly than

[8] Federally-imposed administrative limits on operations at certain other airports were temporarily imposed following a strike by air traffic controllers, but these restrictions were subsequently lifted.

[9] These are delays that would be too expensive to eliminate; that is, delays that users would be willing to tolerate rather than pay enough to eliminate them. For example, airlines (and their customers) would be unwilling to eliminate the possibility of weather-related delays because the cost—limiting the number of flights year round to the level that could be operated in bad weather conditions—would be too high for airlines and their customers.

eliminating them. For example, airlines (and their customers) presumably would be unwilling to eliminate the possibility of weather-related delays because the cost—limiting the number of flights year round to the level that could be operated in bad weather conditions—would be too high for airlines and their customers. Likewise, users might be willing to tolerate a few congested hours per week if the costs of eliminating those delays exceeded the benefits of delay reduction to users.[11]

10) When airport capacity cannot be expanded to meet demand, policymakers have three basic options:

   a) Adopt measures that limit demand (demand management) to levels consistent with available capacity;

   b) Build new runways and/or adopt new technologies that increase available capacity; or

   c) Do nothing (except what is required for air safety) and permit the "first come, first served" system to determine the delay equilibrium.[12]

11) It should be noted that the most efficient solution to the problem of congestion delays may well involve capacity expansion (i.e., option 2, above).[13] The

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[10] See, "The Problem of Social Cost," by Ronald Coase, *Journal of Law & Economics*, 1960, pp. 1-44, for the seminal treatment of social costs.

[11] See, e.g., "Internalization of Airport Congestion," by Jan Brueckner, *Journal of Air Transport Management*, 8 (2002), pp. 141-147.See also "Network Effects, Congestion Externalities, and Air Traffic Delays: Or Why All Delays are Not Evil," by Christopher Meyer and Todd Sinai, University of Pennsylvania, Wharton School, Unpublished Manuscript, October 2001.

[12] This delay equilibrium option -- with the addition of some occasional "jaw boning," – could be used to describe the FAA's approach to congestion at airports such as Boston Logan and San Francisco International which, while busy, may not yet face the same level of "excess demand"(under the first come-first served system) as the HDR airports. For airport such as LGA that would be chronically congested, however, allowing the airport to reach such a delay equilibrium would clearly result in excessive (i.e., inefficient) levels of delay.

[13] Although "demand management" techniques can be used to suppress demand, failure to add runway capacity can be expected to lead to reduced economic efficiency and societal economic when the revenues

focus of this analysis, however, will be on option 1, specifically on the efficiency implications of alternative approaches to allocating runway access when demand (runway access) has been restricted.

Using Market Based Systems To Allocate Runway Access

The Case in Favor of Market Based Slot Allocation

12) When operational restrictions are imposed to limit demand, questions arise as to how the limited access rights should be allocated. The allocation options can be categorized as either market-based or non-market based. Non-market approaches include "grandfathering" (i.e., allocating access rights to existing users),[14] administratively awarding such rights (e.g., by means of DOT's exemption authority or via lotteries). In contrast, market-based approaches rely on prices and markets to allocate scarce resources. Examples of market-based approaches include the use of congestion-based landing fees, auctions and, importantly, secondary markets.

13) Economists typically favor market-based over non-market allocation methods because experience has shown that markets tend to allocate resources more

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generated by the new runway capacity would be sufficient to cover the full cost of those runways. In short, the economically efficient response to congestion-related delays may well involve expanding runway capacity. Thus, policies that focus almost exclusively on restricting demand rather than on facilitating capacity expansion can be expected to result in economically inefficient approaches to congestion-related delay.

[14] When runway access restrictions were first imposed at HDR airports, access rights (called "slots") were initially awarded to the carriers then serving each airport (i.e., "grandfathered") based on each carrier's level of service at that airport when the HDR was adopted. As additional operations became possible, new access rights have been allocated by DOT, typically via its discretionary (exemption) authority as well as by lottery. Although slots at HDR airports were initially allocated to the carriers then operating them, most of the slots currently held by airlines serving HDR airports have been acquired by their present owners via purchase—often at substantial prices. Thus, to the extent that any scarcity rents that accrued to airlines as a

efficiently than non-market methods and because rising prices induce competitive firms to enter or expand existing capacity to meet market demand.

14) Perhaps the main benefit of market-based allocation methods is the expectation that their adoption would alleviate the volume-related delays that can occur when demand exceeds available capacity.[15] The anticipated delay reductions would result from increasing prices to a level where the demand for runway access equals the number of hourly flights that can be accommodated by the existing runways. In the short run, well-designed market mechanisms allocate scarce resources to those who value them the most, and hence, could be expected to put scarce resources to their most economically valuable uses.

15) In addition, market-based allocation methods tend to encourage the efficient allocation of resources in the long run because, as capacity becomes scarce, rising prices are expected to attract the capacity-increasing investments needed to drive prices down to long run competitive levels. Thus, market-based allocation methods can provide both a signal that new investment is needed and an economic incentive for investors to make such investments.[16]

Some Important Caveats

16) Nonetheless, there are a number of circumstances where it is generally recognized that markets cannot be relied upon to produce an efficient allocation of resources. For example, where sellers enjoy monopoly or

result of HDR, they were captured by the original slot holders when they sold those slots. For subsequent acquirers, the cost of slots represents a significant capital investment.

[15] See Docket DOT-2001-9849 at 4397; also Docket FAA-2001-9854-1 at 31741.

[16] As discussed below, however, even this theoretical virtue is open to doubt in the case of airports since both the need for new capacity and the inability (or unwillingness) to provide it have been apparent at the nation's most congested airports for many years.

substantial market power —as is common in the case of airports -- permitting unregulated prices to be charged for access would likely result in higher prices and lower output than would be economically efficient.

17) Likewise, where the cost of establishing and operating a market allocation system exceeds the expected benefits—as would be the case at airports where existing supply of runway capacity consistently exceeds demand for access to those runways—using auctions or congestion-based landing fees would only add costs without improving the allocation of runway resources.[17] In the few cases where inefficient levels of congestion-related delay have arisen because of chronic excess demand (e.g. at LGA), the FAA has dealt with the problem directly by capping the number of operations at levels consistent with the available capacity.

18) A similar caution is in order regarding the ability of some market based allocation systems to provide information about the need for—and thereby to attract—new investments that would increase capacity.[18] But there is little evidence that an inability to raise the capital (rather than political or environmental opposition) has prevented the few seriously congested US airports from expanding runway capacity. On the contrary, the added revenues that could be generated by adding runway capacity at these high-demand

[17] As discussed above, volume-related delays do not appear to be a widespread or significant problem for U.S. commercial aviation. Even at Boston Logan, an airport that has experienced substantial delays, the FAA has determined that "airline overscheduling does not represent a significant cause of recent delays a Logan Airport." *Logan International Airport, June 2002 Final Environmental Impact Statement*, at ES-38. Likewise, scheduled traffic at SFO and PHL "can be handled effectively during good weather conditions." FAA *2001 Capacity Enhancement Plan.*

[18] That information is already available (or could easily be obtained) from the existing slot market for slot-controlled airports.

airports would likely be more than sufficient to fund the runway development.[19] And if no new capacity is likely to be added regardless of whether any of the proposed options is adopted, it would be disingenuous to suggest that the adoption of a market-based allocation system would be necessary—or even helpful—in adding runway capacity. Thus, to a considerable extent, proposals to use auctions or congestion pricing to reduce delays at US airports appear to be a "solution in search of a problem."

19) In addition, the "market based" allocation methods often espoused by policymakers and some economists have frequently failed in important respects to satisfy the conditions necessary for market-based systems to allocate resources efficiently. For example, where the expected revenues generated by the additional runway capacity would be sufficient to cover its cost -- circumstances that clearly exist at the few U.S. airports facing significant congestion problems -- adding runway capacity would be the best way to enhance economic efficiency and increase society's economic welfare. Yet policymakers often fail even to consider this efficiency and welfare-enhancing option.

20) Likewise, policymakers have often failed to recognize (or even to acknowledge) the critically important role of secondary slot markets in ensuring the efficient allocation of runway access rights.[20] Although well-

[19] Chicago's proposed multi-billion runway development and capacity enhancement proposal for ORD, for example, apparently would be funded from existing revenue sources.

[20] For example, the USDOT RFC failed to mention secondary markets although it specifically included auctions, congestion pricing, and peak-period pricing as "market based approaches." RFC at 43948. Nonetheless, there are numerous examples of secondary markets throughout the economy, including major stock, futures and commodities exchanges, as well as more recent creations like eBay.

designed auctions or landing fees could, in theory, produce an efficient initial resource allocation, on-going (i.e., "dynamic") efficiency requires a cost-effective means of reallocating resources as market conditions and participants change. Hence, the ability to exchange resources in a secondary market is essential to maintaining overall efficiency.

21) Finally, the adoption of either auctions or congestion pricing runs the risk of creating economically perverse incentives for airport proprietors, a problem that has been recognized by numerous governmental authorities that have considered permitting airports to levy "market-based" access charges. "[A]irports are often monopoly providers of service within their particular regions, and there is a risk that they will have an incentive to under-invest in capacity in order to exploit their monopoly position…. If all revenue were collected by airport operators it would generate large financial surpluses which may blunt [their] incentives for efficient behavior, including the investment needed to relieve the constraint."[21] Similarly, authorities in Australia concluded "while higher airport charges may signal clearly the need for new investment, that investment may not be forthcoming if the airport retains the scarcity

[21] *The Role of Market Mechanisms in Airport Slot Allocation*, a report prepared for the European Commission by Coopers & Lybrand, Chris Castles, at 11, 1997.

rents."[22] And it was for these reasons, among others, that the USDOT promulgated its policy governing airport rates and charges. [23]

Issues Raised by Alternative Market Based Allocation Systems

Congestion-Based Landing Fees

22) Even if one ignores the well-documented problems inherent in any politically controlled (or motivated) system of rate regulation, establishing efficient, market-clearing levels for congestion fees would not be a simple matter. The rate setting authority first would have to estimate the full cost of congestion-related delays to users – and, hence, how much they would be willing to pay to eliminate those delays.[24] Starting with that estimated price, authorities would then have to reset prices iteratively until the level of landing fees required to produce the efficient number of flights could be determined. And while this experimentation is underway, prices will inevitably be set at inefficient levels, resulting either in a waste of scarce slot resources (when prices are set above efficient levels) or excessive congestion (when landing fees are set below efficient levels). Thus, "whether or not a regulatory body or airport

[22] *Price Regulation of Airport Services, Inquiry Report of the Australian Productivity Commission*, January 2002, at 442. "[W]hile market clearing prices may provide good signals to airports of where new capacity is desired, they may not provide good incentives to actually deliver it at the socially desirable time," quoting from UK CAA, *Heathrow, Gatwick, Stansted and Manchester Airports' Price Caps*, November 2001, p. xiv. It should also be noted that any scarcity rents accruing to airlines as a result of HDR were captured long ago by the original slot holders when they sold those slots. For subsequent acquirers, the cost of slots represents a significant capital investment.

[23] Because "ownership" of runway access rights would vest in users rather than with airports, the use of secondary market would also obviate the problem of airport market power that would result if slots were controlled by airports.

[24] See Bruckner, op cit.

administrator would (or could) choose the appropriate levels of peak and off-peak prices both to avoid congestion and to utilize capacity optimally is not clear."[25]

23) And since the demand for access rights (slots) can vary widely depending on the time of day, time of year and changing economic circumstances, congestion fees would have to be changed constantly in order to continually clear the market.[26] Thus, "the amount of information required to implement peak and off-peak pricing may be formidable" and those responsible for setting such fees would likely find it extremely difficult to keep up with constantly changing demand conditions.[27] As a result, the administrative costs required to operate a system of congestion-based landing fees would be substantial. And, like most other airport costs, these administrative costs would be borne by airport users – including airlines, passengers and shippers. It therefore seems unlikely that -- As a purely practical matter -- congestion pricing would enhance economic efficiency at US airports.

24) Moreover, since the FAA has already determined the effective runway capacities for U.S. airports as part of its responsibility for aviation safety, it is simply not necessary to risk the significant efficiency losses that are likely to

[25] *Comment of the Staff of the Bureau of Economics of the Federal Trade Commission*, Study of the High Density Rule, Docket No. 27664, November 23, 1994, page 49.

[26] …[T]he demand for air travel (both at peak and off-peak times) will fluctuate with changes in the business cycle, seasonally, and as a result of purely random events such as terrorist threats and the weather. If administratively determined prices cannot respond quickly to cyclical and random changes in peak and off-peak demand, the welfare of air travelers may be reduced. If prices are set too low, travelers may be faced with congestion and congestion related delays; if prices are set too high, airport capacity may be underutilized as the number of operations falls below levels necessary to control congestion. ..In practice, there may be difficulties in estimating and setting accurately the structure and level of airport charges which would match supply and demand for airport capacity taking into account the peak profile of demand."" U.S. FTC (1994), op cit, at 49.

result from such regulatory price experimentation. Rather than trying to determine experimentally both the efficient levels of capacity and price, it seems far more sensible to treat the capacity (e.g., the number of slots per hour) as given and then let the market determine the appropriate price – which is what currently happens in the secondary market for HDR slots.

25) Moreover, there is little or no economic advantage to be gained from congestion fees when the effective capacity of the runways has been already determined. "If that capacity is known and reflected in the hourly slot quotas, the prices at which slots trade will fluctuate as demand fluctuates: higher prices during high demand periods, and lower prices during low-demand off-peak periods. Thus, given the level of capacity, *market forces will lead naturally to peak and off-peak prices* [emphasis added]. The only information that regulators or airport administrators need is an estimate of the capacity of the airport. Since [that] capacity does not generally change from day to day or hour to hour, the degree of regulatory oversight necessary to administer slot-based regulation is modest."[28]

26) Thus, even if congestion fees could, in principle, produce allocations as efficient those obtained from reliance on secondary market slot trading, the latter approach has a significant advantage in terms of the level of knowledge

[27] Castles, Coopers & Lybrand, op cit, at 11.

[28] Although "[s]ome critics promote the use of price rather than quantity [i.e., slot] regulation as the appropriate regulatory instrument, [t]he underlying reason for this preference is not always clear. While *market* prices are superior economizers of information compared to administratively set output levels, *administratively set* prices do not necessarily possess the same advantage (citation omitted). " U.S. FTC (1994), op cit at 49.

required of the government. As a result, "it appears likely that such a [congestion] pricing structure is not superior to slot-based regulation."[29]

Auctions[30]

27) Because auctions (like secondary markets) would entail the sale of a defined number of runway access rights (slots) corresponding to an airport's actual runway capacity, auctions could avoid some the efficiency losses inherent in the iterative allocation system required by the use of congestion fees. But even if an auction system were adopted, a secondary slot market would still be necessary to ensure that the allocation of slots remained efficient between auctions.[31]

28) In short, an auction system is not necessary to ensure the efficient allocation of slots since *regardless of how those slots are allocated initially*, a properly functioning secondary market would permit the reallocation of slots to their highest valued uses.[32]

29) In addition, if the use of auctions is contemplated for the reallocation of existing slots (rather than simply the allocation of newly created slots),[33] it would raise significant issues regarding the design and management of an efficiency enhancing slot auction. In particular, the design of an auction covering multiple (capacity constrained) airports would require considerable

[29] FTC (1994) op cit at 49-50.
[30] My analysis of auction theory and practice has benefited from the assistance of my LECG colleague, Darin Lee, an expert in the fields of auctions and game theory.
[31] As previously discussed, first come, first served would remain the most efficient allocation method until demand for access/slots consistently exceeds the available runway capacity.
[32].. Moreover, so long as slots can be freely traded in a secondary market, the initial allocation will affect wealth distribution rather than efficiency. CF, Coase, *op cit*.
[33] It would raise potentially thorny legal issues – specifically regarding arguably unlawful "takings" -- unless slot holders were fairly compensated for the loss of their investments existing slots at HDR airports.

expertise and expense as well as sophisticated software and bidding facilities. The complexities in designing an economically sound slot auction arise principally from the interdependencies inherent in the airline business. That is, "there are strong interdependencies between the values of different slots, which are only useful to an airline as a component of a viable schedule. Airline's schedules establish the relationships between connecting services and these relationships determine the value of slots to individual airlines."[34] For example, these schedule interdependencies mean that the value an airline serving LGA-DCA places on a 7:00 AM departure slot from LGA will depend on whether or not it also holds an 8:00 AM arrival slot at DCA. Similarly, there are important complementarities between slots at the *same airport* for different times of the day. That is, the value an airline places on an arrival slot will depend on whether or not it is able to secure a corresponding departure slot later in the day.

30) It is well established—both from a theoretical perspective and from the experience of numerous radio-spectrum auctions worldwide—that simultaneous auctioning of related resources is efficiency enhancing because it allows firms to aggregate portfolios of complementary resources.[35] Thus, to produce efficient outcomes, an auction for slots would require that all slots at an airport be auctioned simultaneously: "To allow firms to establish

[34] Castles, op cit, at 10.

[35] See for example, "The Efficiency of the FCC Auctions", by Peter Crampton, *Journal of Law & Economics,* 41, pp. 727-736, October 1998 or "Synergies in Wireless Telephony: Evidence from the Broadband PCS Auctions," by Larry Ausubel, Peter Crampton, Preston McAfee and John McMillan, *Journal of Economics and Management Strategy*, 6:3, 497-527, 1997.

meaningful service patterns, any auction should be a simultaneous one."[36] Moreover, in order for an auction process to be able to allocate access rights efficiently throughout the national (or international) aviation system, the simultaneous auctioning of access rights at all slot-constrained airports would be required, thus adding considerably to the cost and complexity of the resulting auction.

31) To be fully efficient, moreover, an auction should also permit airlines to submit package bids (i.e., to make bids conditional on winning matched "pairs" of take-off and landing slots at different airports or sets of slots at the same airport).[37] Indeed, three leading auction experts noted that "the auction must allow package bids, in which bidders can express preferences for packages of items, rather than just individual items."[38] But package bidding would require an extremely complex auction. "The rules for a [slot] auction that took account of this interdependence would therefore [have to] be highly complex in order to allow, for example, for multiple contingent bids with different values bid depending on the complementary services under different outcomes from the overall auction. In practice, no such auctions have ever been implemented."[39]

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[36] Comments of the United States Department of Justice, Docket No. FAA-2001-9854-76.

[37] For example, airlines should be able to bid for a matched slot pair involving a departure at LGA and an arrival at DCA. Likewise, they should be able bid on a portfolio of arrival and departure slots at any constrained airport which best fit their overall network schedule.

[38] See Comments of Peter Cramton, Lawrence Ausubel and Paul Milgrom, Docket FAA-2001-9852, FAA-2001-9854.

[39] Castles, Coopers & Lybrand, op cit, at 10. The need for "package" bidding in auctions with synergistic resources arises from what auction practitioners refer to as the "exposure" problem. The exposure problem arises when bidders trying to assemble portfolios of complementary resources bid above their standalone value for individual objects, with the expectation of winning all desired resources, thus capturing economic "synergies."

32) Although there has been much research on the potential efficiency gains of package bids,[40] they have yet to be implemented in any major auction. The FCC is currently proposing to use package bidding in its upcoming auction for spectrum in the upper 700 MHz band. But implementing even this relatively simple package bidding system has proven to be exceptionally difficult in practice, and the upper 700 MHz auction has already been postponed five times while the FCC attempts to work through these (and other) difficulties.[41]

33) An auction involving package bidding would impose significant costs on both the FAA/DOT—to design the rules, software and bidding facilities necessary to administer such an auction—and on airlines that would be forced to devote considerable resources in preparing for the auction. By way of illustration, the FCC's proposed auction for spectrum in the upper 700 MHz band, which involves only 12 licenses and 4,095 potential packages, is much simpler than any potential slot auction involving package bidding. Even though the prospective bidders in that auction had considerable experience in spectrum auctions, they expressed grave doubts regarding the cost and complexity

[40] For a survey of recent developments in package bidding, see "Combinatorial Auctions: A Survey," by Sven de Vries and Rakesh Vohra, forthcoming in *INFORMS Journal on Computing*.

[41] Developing an efficiency enhancing slot auction that allowed for package bids would be considerably more complex than for the FCC's upper 700 MHz auction. The current proposal for the upper 700 MHz auction involves a total of only 12 individual licenses, which in turn generate 4,095 possible license packages. But a slot auction involving even a single airport (i.e. ignoring for the time being the interdependencies between airports) would involve significantly more slots, and thus, substantially more potential packages. For example, auctioning only one arrival and one departure slot at a single airport for each of the 16 hours between 6 am and 9 pm (i.e., 32 slots in total) creates over *600 million* potential packages even after restricting packages to have an equal number of arrival and departure slots. But the FAA's proposed auction option for LGA would require auctioning substantially more (i.e. 246) slots (See FAA-2001-9854-1 at 31747-31748) and the DOJ has asserted that "To be effective in promoting competition, an auction should have a large number of slots available for bidding at regular intervals..." (See Comments of the United States Department of Justice, Docket No. FAA-2001-9854-76.)

required by the use of package bidding.[42] A slot auction utilizing package bids would involve millions if not billions of potential packages, a substantial portion of which airlines would be forced to evaluate. "Compared to most of the other costs involved in conducting combinatorial auctions, bidder valuation costs are relatively less affected by advancing technologies, particularly when the asset valuation process requires substantial human inputs."[43]

34) In sum, while auctions could produce a more efficient *initial* allocation of newly created slots than the administrative approaches heretofore favored by USDOT, the development and implementation of an economically sound auction methodology for large scale application (i.e., involving existing slots and multiple airports) would be both highly complex and costly for both the auctioneer and the prospective bidders. Some of these complexities might be avoided by using a simpler auction format and then permitting slots to be reallocated in a secondary market. But in that case, the ultimate efficiency of the system would result from the use of secondary market, thus making it clear that *the primary effect of using auctions would be to redistribute wealth from existing slot holders (mostly airlines) to airports.* It is difficult to see an

[42] For example, Verizon Wireless stated "The level of complexity that combinatorial bidding brings to this auction greatly increases the amount of analysis by bidders and has a major impact on bidding strategy." (Comments of Verizon Wireless, DA 00-1075, page 4). Similarly, Voicestream Wireless stated "… in spite of its substantial expertise, VoiceStream believes that the rules for combinatorial bidding are unusually complicated and that it will be extraordinarily difficult to create software to track the auction and develop bidding strategies." (Comments of VoiceStream Wireless, DA 00-1075, page 4).

[43] "Ascending Auctions with Package Bidding," by Lawrence M. Ausubel and Paul Milgrom. Unpublished working paper, University of Maryland and Stanford University, April 25, 2002.

efficiency justification for this type of "robbing Peter to pay Paul" approach to slot allocation.[44]

Secondary Slot Markets

35) For secondary slot markets to allocate slots efficiently, slot holders must enjoy cognizable legal ("property") rights in the slots they hold.[45] Although these ownership rights need not be full and complete (e.g., "fee simple" title under English and American common law), they must be substantial enough in extent and duration to justify the expense of exchange. But in the case of slots, this requires the recognition of private property rights in resources that many consider to be "public" property. Nonetheless, it is well established in economics that conferring private rights can lead to a more efficient use of resources than if those resources are treated as public goods.[46]

36) In any event, the debate in the United States as to whether slots are public or private has been resolved – temporarily, if not definitively -- since courts have recognized the existence of some private property rights in slots at HDR airports. As a result, airport slots are now subject to a market-based allocation system—and have been since the adoption of the buy/sell rule in 1985.[47] Indeed, the secondary market that exists in the United States for the purchase,

[44] In addition, since the broad use of auctions would require the taking of slots from existing slot holders, it is likely to result in litigation and considerable uncertainty in the financial markets where slots have been long viewed as airline assets and relied upon by lenders and investors as collateral.

[45] This conditions exist in the United States (for HDR airport slots) and, to a somewhat lesser extent, for slots at airports in the United Kingdom.

[46] In addition, although the distribution of property rights can affect the distribution of wealth (as between recipients and non-recipients), it does not necessarily have efficiency implications. And if the aim of slots policy is (as I believe it should be) to facilitate the most efficient use of these scarce resources, the use of auctions or congestion fees for the purpose of redistributing wealth cannot be justified on efficiency grounds

sale and/or leasing of airport slots is the only system in currently in use that approaches a fully market-based system for airport access rights.[48]

37) The ability of airlines to acquire HDR access rights in the secondary market provides an on-going mechanism for reallocating scarce resources to new and more productive uses and users.[49] "An economically efficient solution… would limit the use of the resource and allocate right of use to those who value them highest. The HDR…[has] largely accomplished this by creating a slot market …[that] allowed slots to be transferred to carriers with the most highly valued flights. Other things equal, the value of a given flight rises as consumer demand for the flight rises. Thus, the slot market—that is, the ability of carriers to buy, sell and lease slots freely—helps ensure that the flights offered are those that consumers value the most."[50]

38) Further, FAA slot data indicate that the market for slots is a reasonably active one. During the six-month period from March to August of 2001, for example, the FAA recorded approximately 1,328 slot transactions (leases and sales).[51]

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[47] Since 1985, carriers have been permitted to buy, sell and/or lease slots at HDR airports. See Amendment 93-49, 50 Fed Reg 52195.

[48] Certain property rights in slots at UK airports have also be recognized and these slots can be traded -- but subject to more restrictive conditions than apply in the US market.

[49] Secondary markets have also been adopted to reallocate scarce resources in other regulatory contexts. E.g., The Clean Air Act permits the purchase and sale of emission credits in order to reduce emissions as cheaply and efficiently as possible.

[50] *Study of the High Density Rule*, Comments of the Staff of the Bureau of Economics of the Federal Trade Commission, Docket No. 27664, November 23, 1994, at 7. "The HDR was adopted in order to allocate existing capacity. If that capacity is known and reflected in the hourly slot quotas, the prices at which slots trade will fluctuate as demand fluctuates: higher prices during high demand periods, and lower prices during low-demand off-peak periods. Thus, given the level of capacity, market forces will lead naturally to peak and off-peak prices. To implement [such] slot-based regulation, the only information that regulators or airport administrators need is an estimate of the capacity of the airport. Since airport capacity does not generally change from day to day or hour to hour, the degree of regulatory oversight necessary to administer slot-based regulation is modest."

[51] The FAA does not include one-for-one slot trades when counting transactions. If those transactions are included, the total number of slot transactions would be approximately 3,100 (rather than 1,328).

Four hundred and twenty (420) of these transactions involved weekday slots. Based on 1,296 daily slots, this is *equivalent* to approximately one-third of all weekday slots being transacted once during this six-month period. The turnover for weekend slots is equivalent to a turnover of about 30 per cent of available weekend slots. And slot transactions do not appear to be limited to large network carriers. [52]

39) Nor does the buy/sell system appear to have imposed an unfair or disproportionate burden on new entrants. "HDR [including buy/sell] promotes rather than limits new entry because it creates a market in which potential new entrants can obtain operating privileges."[53] By permitting slot holders to convert their slot holdings into cash, moreover, buy/sell provides incumbent slot holders with strong incentives to sell slots to those—including new entrants—who are willing to pay more for the slots than incumbents expect to earn by retaining them. [54]

40) Although it is often assumed that the combined effect of HDR and buy/sell has caused HDR airports to become more concentrated than airports not subject to

[52] Source: LECG analysis of FAA slots data. Based on 1,296 daily slots. See Docket FAA-2001-9854-1 at 31747. Note that because some slots have been leased or sold more than once during this six-month period, the actual number of unique slots involved in transactions will be somewhat lower.

[53] *Study of the High Density Rule*, Comments of the Staff of the Bureau of Economics of the Federal Trade Commission, Docket No. 27664, November 23, 1994, at 2.

[54] Indeed, the increase in new entry—particularly with small jet aircraft—has been so great as to prompt the inclusion of an option in the recent FAA RFC that would have permitted the imposition of minimum aircraft size limits on aircraft serving LGA. In addition, all of the recent exemptions from HDR at LGA have been awarded to new entrants and small carriers. As a result, such carriers currently operate a significant share of slots at LGA.

HDR, that assumption does not appear to be correct.[55] Concentration levels at LGA and Washington Reagan National (DCA), for example, are lower than the average for other comparable, non-hub airports. This is shown in the following Exhibit.

HHIs at The 15 Largest Non-Hub US Airports, in 2001

Airport	HHI	O&D Rank
OAK	4,426	14
MDW	3,057	11
SJC	2,261	13
BWI	2,203	6
HNL	2,125	12
DCA	1,875	*10*
SAN	1,870	9
SEA	1,832	5
JFK	1,700	*15*
LGA	**1,676**	**3**
BOS	1,674	4
TPA	1,410	8
MCO	1,408	2
FLL	1,378	7
LAX	1,348	1
Mean	**2,016**	
Median	**1,832**	

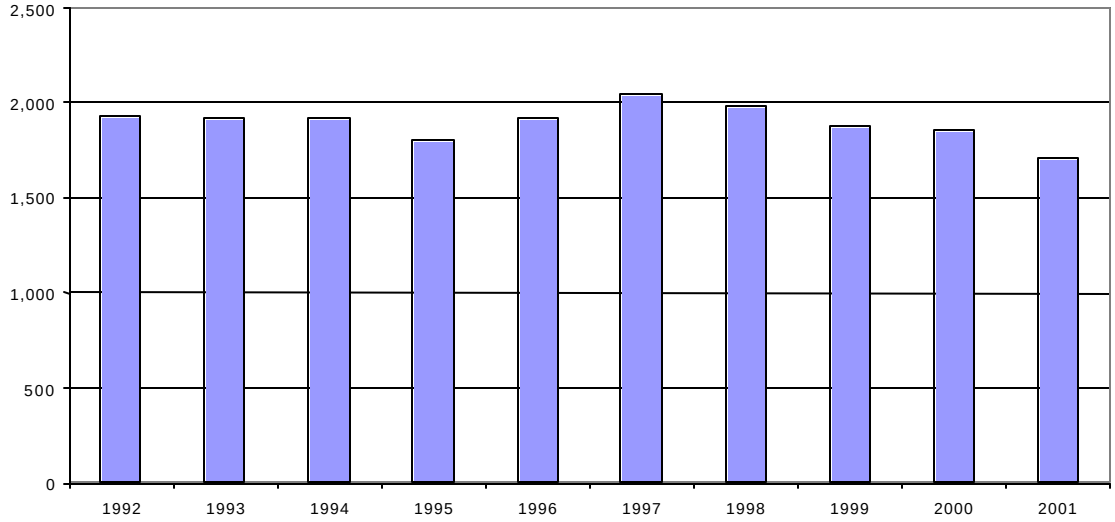
Notes: HHIs based on domestic O&D passengers.
Source: U.S. DOT DB1A Database.

41) In addition, concentration at the most severely constrained HDR airport has been declining—whether measured by actual slot usage (arrivals and departures) or slot ownership. Thus, ,in 2001 the HHI at LGA measured in terms slot usage was at its lowest level in a decade, as shown in the figure below. Likewise, the HHI based on slot ownership fell from 1,747 in 1993 to

[55] And even if HDR had produced increases in concentration, there is little reason to believe that the outcome would have been any different under any other market based allocation system – including auctions and congestion fees.

1,661 by April of 2001.[56] Likewise, concentration measured in terms of O&D

Figure 1
HHI of LGA Flight Operations: 1992-2001



Notes: Aircraft Departures and Arrivals at LGA. Source: U.S. DOT T-100 Database.

traffic at LGA for 2001 was 1,680, a level that was lower than the1996 HHI level of 1,720. [57]

Summary and Conclusions

42) Not all market-based allocation systems are created equal, at least when it comes to the allocation of runway access. In order for market-based approaches to allocate runway access rights efficienctly, it is first necessary that demand for access to those runways exceed available runway capacity to the point of causing economically inefficient levels of delay. In short, runway capacity must be scarce. But according to FAA data, volume-related delays are

[56] Source: 1993 HHI is from "Study of the High Density Rule," Docket No. 27664, U.S. Federal Trade Commission, November 23, 1994; 2001 HHI was calculated by LECG based on FAA slot data for April 2001.

minimal on a national basis. For this reason, there appears to be little justification for most US airports to consider the use of auctions, congestion fees or other "demand management" options.

43) Where access rights are already subject to a market-based allocation/reallocation system -- as is the case at HDR airports -- adoption of other demand management measures cannot be expected to reduce delays or otherwise improve efficiency. Rather, the primary effect of adopting a system based on auctions or congestion pricing would be to transfer wealth from airlines to airport proprietors—without adding runway capacity or otherwise alleviating delays and at the risk of causing considerable economic harm. Yet policymakers do not appear to have given much consideration to evidence that a secondary market is likely to be more effective than auctions or congestion fees in ensuring efficient allocation of scarce runway access rights at congested airports.

44) Moreover, it is not clear why—or how—efficiency at HDR airports would be enhanced by the use of auctions or congestion pricing. And even if a such a system were adopted, secondary markets would still be required to ensure dynamic efficiency, i.e., continually reallocating access rights to their highest valued uses. Thus, regardless of how runway access rights are allocated initially, a secondary market will still be required to ensure that slots continue to be allocated efficiently.

[57] The average HHI for 1994-2000 using O&D traffic at LGA was 1,674 compared to 1,680 for 2001. Source: LECG analysis of US DOT data.

45) Congestion fees (including peak pricing) and auctions are also plagued by serious practical problems that raise grave doubts not only as to their effectiveness but also as to their very workability.[58] In this context, it is perhaps worth noting that at no commercial airport is runway access allocated solely—or even principally—by means of auctions or landing fees (including peak period pricing).[59] In part, this may be due to the fact that there are only limited airports where such methods might be able -- even in principle -- to improve efficiency. But the absence of auctions and congestion pricing may also be due to the fact that these allocation methods suffer from problems that appear serious enough to cast substantial doubt on their ability to allocate scarce runway access resources efficiently.

46) Finally, in the relatively few cases where demand at airports not covered by HDR exceeds capacity and where the potential for capacity expansion and other technical "fixes" has been exhausted, policymakers should consider extending the HDR to those airports in order to ensure that scarce runway access rights continue to be allocated as efficiently as possible over time. And regardless of the method used initially to allocate scarce runway access rights,

[58] In addition, such approaches are likely to diminish the incentives for airport proprietors to develop new capacity in response to increasing consumer demand for runway access: If airport proprietors cannot profit from the scarcity value of slots, they are more likely to expand capacity in order to increase their revenues and profits.

[59] Thus, even London's Heathrow and Gatwick airports, where landing fees substantially exceed the airports' actual (historic) costs, runway access requires airlines to hold time-specific slots. These slots were initially allocated based on historical usage. Subsequent users have acquired slots via acquisition (e.g., AA and UA by acquiring TW and PA's U.S.-LHR rights) or by administrative allocation as new slots have been created.

a secondary market will still be needed to ensure that slots continue to be efficiently allocated over time. [60]

[60] For newly created slots (e.g., from an increase in runway capacity), it makes little difference in terms of efficiency how those slots are allocated to airlines -- so long as slot holders can freely buy, sell or trade their slots in a functioning secondary market.