Market-Based Alternatives for Managing Congestion at New York's LaGuardia Airport

by

Michael O. Ball[1], University of Maryland <mball@rhsmith.umd.edu>
Lawrence M. Ausubel, University of Maryland <ausubel@econ.umd.edu>
Frank Berardino, GRA, Inc. <frankb@gra-inc.com>
Peter Cramton, University of Maryland <cramton@umd.edu>
George Donohue, George Mason University <gdonohue@gmu.edu>
Mark Hansen, University of California, Berkeley <mhansen@newton.me.berkeley.edu>
Karla Hoffman, George Mason University <khoffman@gmu.edu>

ABSTRACT

In the paper, we summarize the results of a project that was motivated by the expiration of the "High Density Rule," which defined the slot controls employed at New York's LaGuardia Airport for more than 30 years. The scope of the project included the analysis of several administrative measures, congestion pricing options and slot auctions. The research output includes a congestion pricing procedure and also the specification of a slot auction mechanism. The research results are based in part on two strategic simulations. These were multi-day events that included the participation of airport operators, most notably the Port Authority of New York and New Jersey, FAA and DOT executives, airline representatives and other members of the air transportation community. The first simulation placed participants in a stressful, high congestion future scenario and then allowed participants to react and problem solve under various administrative measures and congestion pricing options. The second simulation was a mock slot auction in which participants bid on LGA arrival and departure slots for fictitious airlines.

Key Words: congestion management, market mechanisms, slot auctions, aviation.

1. INTRODUCTION AND BACKGROUND[2]

In much of the developed world congestion management through slot restrictions is a common practice. In Europe, for example, slots are allocated based on EEC and IATA rules [Slot Allocation, 1992]. The guiding principles of slot allocation are mainly "grandfather rights" and the "use-it-or-lose-it" rule. When slots become available because of added capacity, insufficient use, or voluntary relinquishment, they are put in a "pool" and redistributed giving priority to new

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[1] Corresponding author; contact information: Robert H Smith School of Business & Institute for Systems Research, University of Maryland, College Park, MD 20742, USA, 301-405-2227

[2] The material in this section draws heavily on Hansen and Zhang, 2005.

entrants [Fan and Odoni, 2002]. Airlines are allowed to exchange slots, but without financial transfers. These policies have been used at some airports, such as London Heathrow and Paris Charles de Gaulle, since the early 1970s.

The U.S. has a large domestic airline industry with more than 500 commercial airports. In contrast to the European situation, access of airlines to airports in the U.S. is more of a domestic policy issue. At virtually all U.S. airports, runway access is on a first-come-first-served basis. Airport access in these cases is only restricted by the availability of terminal facilities. Slot controls have been used at five U.S. airports. In 1968, the High Density Rule (HDR) was promulgated to reduce delays at Chicago O'Hare (ORD), Washington National Airport (DCA), and three New York airports: Kennedy (JFK), Newark (EWR), and LaGuardia (LGA). The rule was terminated in the 1970s at EWR. The HDR was supposed to expire at the end of 1969 but was extended several times, indefinitely in 1973. At LGA, the HDR limited the hourly slots (landing or takeoff rights) to 68 operations per hour[3] between 6:00 am and midnight. Six slots were reserved for general aviation, military and charter flights, leaving 62 slots per hour for commercial airline flights [Crowley, 2001]. Initially, slots were distributed by a scheduling committee, composed of representatives from different airlines. After deregulation, the scheduling committee process was replaced by the use-it-or-lose-it and buy-sell rules issued by the FAA in 1985. While in principal these rules created a market for slots, airlines proved reluctant to sell them, particularly to new competitors [U.S. Congress, 2000].

In the early 1990s, the FAA granted 42 slot exemptions for air service to LGA authorized by the Federal Aviation Authorization Act. Unlike regular slots, these could not be sold, and were authorized for specific types of flights: new international flights, new entrant airlines, and essential air services. The exemptions and the restrictions on their use reflected compromises between competing forces, including those concerned that slot restrictions stifled competition, and airport neighbors who wished to maintain controls because of noise impacts [U.S. Congress, 2000]. The granting of slot exemptions posed another obstacle to the slot market, as potential buyers conjectured that, through exemptions, they could obtain access to LGA without paying for slots.

[3] An operation is either an aircraft arrival or a departure. In general, arrivals must equal departures in operational equilibrium.

More recently, AIR-21 was enacted in April 2000. This four-year reauthorization bill required that slot controls be eliminated after January 1, 2007. It also encouraged service to connect the HDR airports and small hub or non-hub airports. AIR-21 granted immediate exemptions to the slot restrictions for flights by regional jets with less than 72 seats and providing nonstop service to small-hub or non-hub airports, while permitting new entrant carriers and limited incumbent carriers to apply for additional exemptions [U.S. Congress, 2000]. By the fall of 2000, over 300 exemption requests per day had been approved for LGA, with a similar number still pending. Delay at LGA dramatically increased. Many observers believe that after AIR-21, these delays had a severe impact on operations throughout the NAS [Metron Inc., 2000; Donohue, 2002; U.S. House of Representatives, 2001]. One analysis by MITRE showed that, on one particular day, “some 376 flights traveling to 73 airports experienced flights delays because their aircraft had passed through LaGuardia at least once that day.”

The airport operator, the Port Authority of New York & New Jersey (PANYNJ), considered the LGA situation to be untenable, and, on September 19, announced that it was imposing a moratorium on additional flights there. Following this lead, the FAA announced a plan to rescind the AIR-21 slot exemptions that it had already granted and to redistribute some of those exemptions by a lottery. The FAA described this as only a “temporary” solution that would terminate on September 15, 2001. The FAA capped the number of operations per hour for commercial flights at 75. In this way, more than 100 flights permitted under AIR-21 were eliminated, and the remaining exemptions allocated by a lottery on December 4, 2000. The same slot limits and methods for allocating slots remain in place today, but the AIR-21 mandate to remove slot controls at LGA by January 1, 2007 also remains.

In a 2001 Notice of Proposed Policy Options, the FAA and the PANYNJ proposed several potential options for “managing capacity at LaGuardia Airport” [Federal Aviation Administration, 2001]. The options included congestion-based landing fees, auctioning of landing and take-off rights, and various administrative alternatives. The latter included one giving priority to larger aircraft by having successive rounds of scheduling slots in the early rounds restricted to larger planes. A second administrative option called for gradually reallocating slots by withdrawing a percentage from large slot holders and redistributing them using a lottery. Under a third option, slots were allocated in four “tranches” including a baseline allocation of 20 per day, a set of small community slots, a set of slots that would be allocated based on airlines passenger traffic, and a set that would be auctioned.

2. BACKGROUND ON PROJECT

In October of 2004 the U.S. Federal Aviation Administration (FAA) and the U.S. Department of Transportation -- Office of the Secretary (DOT) contracted with NEXTOR, the National Center of Excellence for Aviation Operations Research, to carry out research related to congestion management options for LGA. NEXTOR, an FAA center of excellence, is a consortium of five universities: George Mason University (GMU), the Massachusetts Institute of Technology (MIT), the University of California, Berkeley (UCB), the University of Maryland (UMD) and the Virginia Polytechnic Institute and State University (VPISU). The specific organizations involved in this project were GMU, GRA, Inc, Harvard University, MIT, UCB and UMD. This research was aimed at supporting decision-making relative to the expiration of the HDR at LGA in January of 2007. This paper summarizes the results of that project. We emphasize that the contents of this paper solely represent the work product and opinions of the authors and do not in any way represent any U.S. government policy or the opinions of the FAA or DOT.

The goals of the project were to develop and compare administrative and market-based mechanisms for controlling congestion at LGA. A specific project task was to develop a mechanism for auctioning airport arrival and departure slots. The inclusion of this task did not reflect any bias as to the merits of such an auction, but rather the need for a practical slot auction mechanism for auctions to be a viable policy alternative. An important project feature was the execution of two strategic simulations. Strategic simulations are experiments in which actual decision makers participate in a simulated exercise. Probably the best know examples of such simulations are the “war games” used to test military preparedness. These simulations can provide substantial value in three areas. First, they provide a reasonably realistic projection of the impact of various planned procedures and tools. It is often the case that such procedures lead to impasses or very difficult-to-resolve issues. These uncomfortable situations actually are the source of the second advantage of strategic simulations: the ability to uncover the need for procedures, tools or rules that were completely unanticipated at the beginning of the experiments. This distinguishes such simulations from exclusively computer-based simulations and analyses. The third very important role they play is in the education of the participants and others observing and studying the strategic simulation. By observing and recording the unfolding of events and the players' subsequent decisions, one gains a deep and intuitive understanding of the issues involved.

The first simulation was held at GMU in November of 2004. It was principally focused on evaluating and comparing administrative measures and congestion pricing. There were six major game "players" consisting of teams from four airlines, the Federal Government and the PANYNJ, which operates LGA airport. Other participants included representatives of other airlines and airports, the Air Transport Association and various experts from academia, industry and government. The game projected the participants to a hypothetical setting in November of 2007. The baseline scenario was an LGA schedule involving approximately 1400 total operations (arrivals and departures), a number that exceeds recommended operational levels. The airline teams adjusted their schedules in response to various government controls put in place. These controls involved Federal Government regulations, administrative restrictions and congestion-based fees. The airline teams made a total of five schedule adjustments. Delay and cancellations statistics were estimated under all scenarios.

The second simulation was held at UMD in February of 2005. Its goal was to test and evaluate a slot auction mechanism and to demonstrate to the community how such an auction might operate. The participants largely coincided with the participants in the first simulation. In this case, six fictitious airlines were created. These were given simplified business plans and financial objectives. Participants were assigned to airline teams, where participants from multiple organizations were quite often assigned to the same team. During the simulation a mock slot auction was executed in which the airline teams bid on, and eventually won/purchased, sets of slots on which to base projected services. The mock auction was supported by a spreadsheet based decision-support tool and a web-based auction mechanism (the web-based mechanism was a custom modification of a commercial product provided by Market Design Inc.). The auction proceeded through five rounds of bidding and ended with a slot allocation among all participating airlines. Teams were given private rooms in which to deliberate in order to develop their bids for each round.

The research team also conducted statistical data analysis, simulations, algorithm designs and other tasks. These resulted in a wide-ranging set of results and recommendations. In this paper, we highlight certain key aspects of the research.

In August of 2006, the DOT issued a Notice of Proposed Rulemaking (NPRM) addressing the expiration in January of 2007 of the HDR at LGA. We will discuss the contents of this NPRM later in this paper. It is important to note that, since it was felt there was not enough time to complete the NPRM review and issue an actual rulemaking, an interim rule was put in place that largely preserves the status quo (HDR) at LGA.

3. BASIC OPTIONS AND TRADEOFFS

In this section we frame some of the basic questions and tradeoffs related to the congestion management options for LGA.

Action or no action? One should consider the option of eliminating the current HDR rule and not replacing it with any new regulation. The severe over-scheduling that occurred during the AIR-21 period, would seem to indicate that there is a significant risk of extreme levels of delays and flight cancellations when all controls are eliminated.

Slots or no slots? A slot is the right to land or takeoff at a particular time (and/or to schedule such an operation). By defining slots, the FAA can control precisely the number of operations that take place and can exercise strong control over airport delays and flight cancellations. In order to control congestion, the no-slot option would have to be combined with some form of congestion pricing. The no-slot option has the advantage of a high level of simplicity – any operator can land at any time, as long as the operator pays the appropriate (congestion) fee. These alternatives are compared in more detail later in the paper.

If slots are used, then should slots be owned or leased? Under the current system, slots have no defined termination dates. The question is: should future slots have well-defined lifetimes? The advantage of having well-defined lifetimes is that there is a formal mechanism that forces slot turnover, allowing, for example, the entrance of new carriers and the expansion of existing carriers.

If slots are used and slots have a finite lifetime, then should an administrative measure or a market mechanism be used to reallocate them? Certainly, the process of defining administrative measures would be challenging due to the significant political pressures that likely would be brought to bear on this process. Further, historical evidence suggests that even after the process was defined, there would be political pressure brought to make exceptions and/or change it. On the other hand, if an administrative measure is put in place, it must be one that provides better access to LGA slots for new entrants and carriers wishing to expand and also that encourages the most productive use of slots. An obvious basis for measuring “productive use” for purposes of administrative allocation is the size of aircraft operated. Other aspects of “productive use” such as the airline customer willingness to pay are outside the reach of administrative measures but would be reflected in market mechanisms. If one were to us a market mechanism, then the process of determining appropriate price levels and appropriate buyers would inevitably take on the form of a type of auction.

If slots are used, then how should an initial slot allocation be determined? The two most likely possibilities are i) to use a market mechanism or ii) to base the initial allocation on the current HDR allocation. If a market mechanism were used, then as discussed above, it would take on the form of an auction. If the current slot level were left in place, then the current (HDR) allocation could be used as the initial allocation (differences in current slot types – HDR vs. AIR21 – would lead to certain complications). If the current slot level were reduced then presumably some sort of *pro rata* formula could be used to reduce, in an appropriate way, the incumbents’ slot holdings. The design of such a formula does not represent a challenging problem but, nonetheless, should be done with careful study.

How can gate and other airport resources be reallocated in a manner consistent with slot reallocations? Any of the schemes proposed here have the potential to cause significant changes in carrier schedules. When such changes occur, carriers will require appropriate corresponding airport resources. It will be important for the PANYNJ to be able to respond with such resources. This issue is discussed later in the paper.

4. THE CASE FOR MARKET MECHANISMS FOR CONTROLLING AIRPORT CONGESTION

The starting point for any discussion of LGA congestion management options must be to ask whether there is any problem with the status quo, i.e. the HDR. The HDR allows for buy-sell transactions. Economic efficiency principles state that if a free market for a good exists then eventually that good is well-allocated, i.e. those that value a good the most are able to obtain that good. Among other things, the eventual “efficient allocation” does not depend on the mechanism used to produce the initial allocation. One can then argue that since HDR allows for a free buy-sell market with many participants that the slots will be, over time, efficiently allocated and, hence, put to their best use. However, historically sales of LGA slots have mainly occurred in situations of carrier-owner distress, e.g. as part of bankruptcy proceedings, and, in particular, new entrants have had extreme difficulties in buying slots from incumbents [U.S. Congress, 2000], [Fownes et al, 2002]. The most evident reason for the seeming failure of this market is that the buyers and sellers are competitors and slots are a key business asset. Thus, even though carrier A values a slot more than carrier B, carrier B will be reluctant to sell the slot to carrier A since that slot will increase the overall competitive position of A. With this in mind, one then might ask whether there is evidence that slots are not being put to their best use at LGA. Assuming that slots are not being put to their best use, one might then ask whether a market-based mechanism might lead to better slot use. In Section 4.1, we summarize the results of a statistical analysis that indicates that the average aircraft gauge (seats per flight) for LGA flight segments is smaller than for comparable non-LGA flight segments in the U.S. National Airspace System (NAS). Section 4.2 contains an overview of recent research that compares LGA service levels that seek to maximize system efficiency with actual LGA service levels. In Section 4.3, we provide some results from the first strategic simulation that indicate that congestion pricing leads to increases in average gauge when compared to "equivalent" administrative measures.

4.1 LGA Average Gauge Analysis

Airlines can provide a given level of passenger capacity by offering more flights on smaller aircraft or fewer flights on larger aircraft. If slots are scarcer at LGA than at other airports, and if slots are being allocated efficiently, one would expect to see larger aircraft operated there. Of course, other factors, including stage length, segment traffic levels, and segment concentration, also affect average aircraft size. In order to compare aircraft size at LGA with other airports, one needs to control for these factors. This section presents evidence that, all else equal, airlines at LGA actually operate *smaller* aircraft than elsewhere in the US. This bolsters the case that the existing slot allocation scheme is inefficient.

An important source of aircraft size variation is whether a flight segment is served by commuter service or regular jet service. Commuter service involves aircraft that are 60 seats or smaller, and is normally provided by commuter airlines through code share agreements with the large jet operators. We investigated whether LGA flight segments are more or less likely to be served by commuters, as opposed to large jet operators. For purposes of our study, we defined a commuter segment as one in which over 80 percent of the flights are 60 seats or less, and a large jet segment as one in which over 80 percent of the flights are over 60 seats. Other segments were excluded from this analysis.

Figure 1 depicts our data—for November 2004—on a log-log plot of two key determinants on service type: traffic density and stage length. The plot shows many LGA commuter segments (the blue squares) are in regions (in terms of density and stage length) where most of the services at other airports are large jet (the pink squares). Statistical modeling, based on a binary probit model, confirms this. In the model, we included length and density (in log form), and a dummy variable for LGA segments, as explanatory variables. We found that the LGA dummy was highly significant.

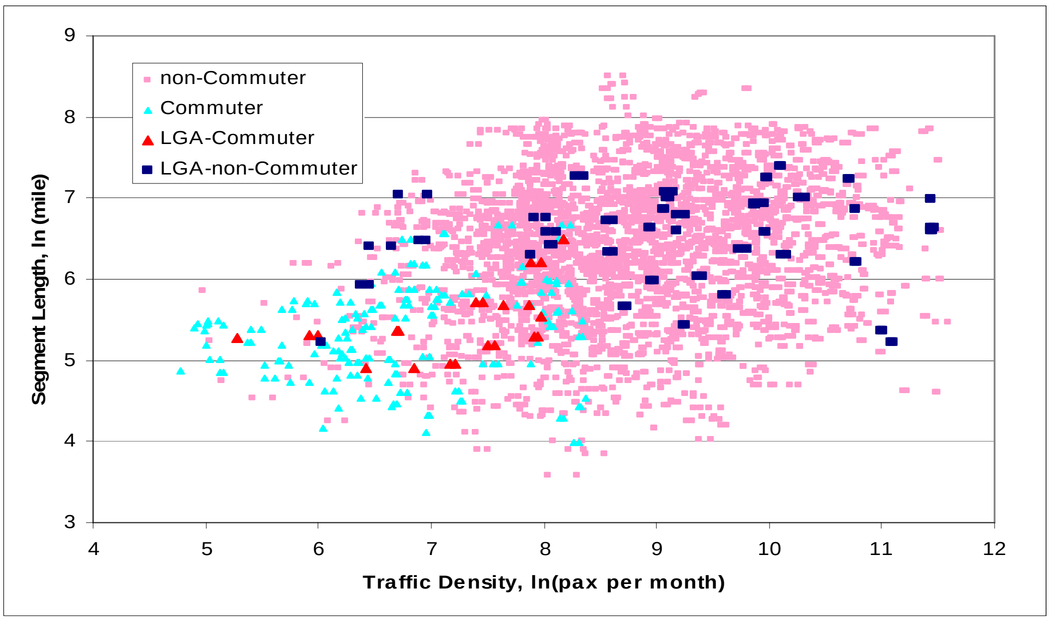

Figure 1: Segment Length and Traffic Density, by Segment Category (November 2004 Data)

We next investigated average aircraft size for large jet services, again comparing LGA and other domestic US flight segments. Figure 2 plots the data for November 2004. The x-axis is the product of segment distance and segment traffic density, which has been found in previous studies to be a good predictor of average aircraft size. While there is considerable scatter, it is clear that for higher passenger-mile (pax-mile) segments average aircraft size is smaller for LGA (the blue diamonds) then for other airports (the pink squares). We estimated a log-linear model relating average aircraft size to traffic density, segment distance, segment concentration (we used the Herfindahl-Hirschman Index (HHI) to estimate the degree of market concentration on a segment), and a complete set of LGA terms including a dummy and interactions between the dummy and the other explanatory variables. The results confirm that average aircraft size for LGA segments tends to be smaller. For the "average" segment at LGA in terms of density, length, and HHI, the difference is about 12 seats—145 for LGA versus 157 for non-LGA segments.

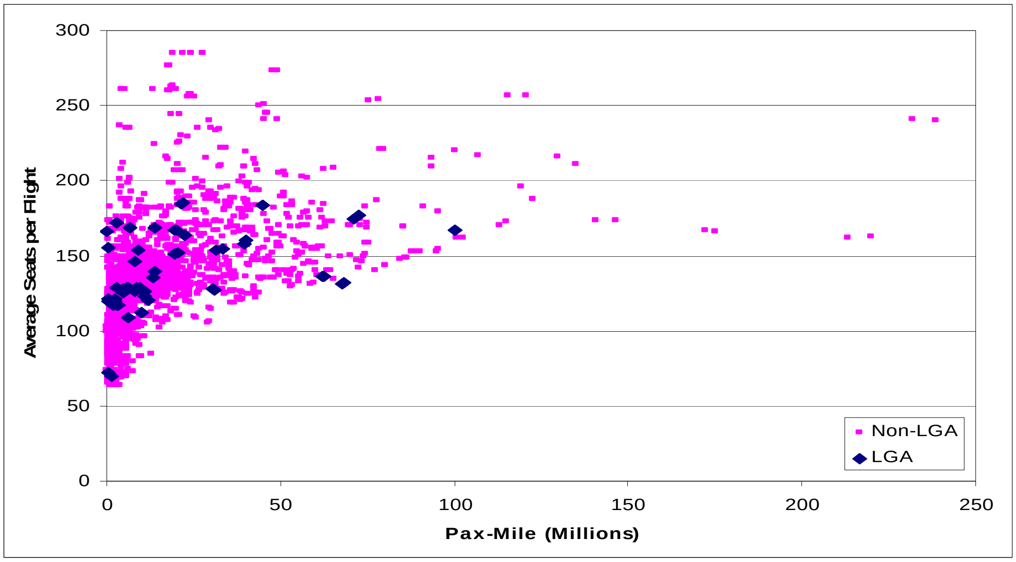

Figure 2: Average Seats per Flight vs Segment Passenger-Miles, by Segment Category (November 2004 Data)

In sum, while it would be economically efficient to adapt to scarce airfield capacity at LGA by up-gauging, our evidence suggests that the actual response has been down-gauging. This suggests that slot allocation policies have, at best, failed to encourage efficient behavior. More likely, they have had the opposite effect, as a result of the slots that are set aside from smaller aircraft under Air-21, as well as the use-it-or-lose it rule that encourages an airline to "baby-sit" its slots in order to retain ownership.

4.2 Comparing Actual LGA Service Levels with System-Efficient Service Levels

It may be that the current LGA schedules and practices produce efficient transportation. To address this question one must decide how to measure efficiency. The airlines need a critical mass of passengers on any given flight to cover the flight's operating costs. A typical rule of thumb is 0.70 Load factor (defined as the fraction of seats filled with paying passengers). The airport authority may want the maximum number of markets (cities) served with the maximum number of passengers traveling to or from the city for each aircraft operation. This measure is frequently measured as the airport's MAP (Million Annual Passengers). The FAA is concerned with keeping aircraft safely separated and separation restrictions lead to a maximum number of aircraft operations before congestion begins to lead to substantial delays. As in freeway traffic, there is a strongly non-linear increase in delay as demand approaches capacity. At LGA, a 16% increase in capacity, from 64 operations/hour to 74 operations/hour, results in over a 300% increase in delay [Le, 2006]. Frequently, different efficiency metrics are in competition with each other. Figure 3 and 4 show how LGA is performing in this light.

Figure 3 shows that the number of operations was almost constant from 2000 to 2002 but experienced a step jump in 2003. There was initially a decrease in the number of passengers carried (presumably due to both a recession and to the 9/11 terrorist incident) but a steady increase from 2002 to 2005. The average number of passengers per aircraft declined from 2000 to 2002 and sharply decreased in 2003 leading to an increase in the number of operations leading to significant delays shown in Figure 4.

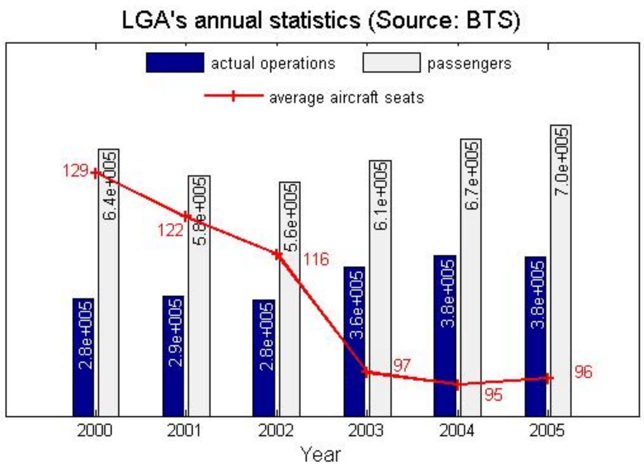

Figure 3: BTS data showing the decrease in average aircraft size with increasing passengers and operations [Le, 2006]

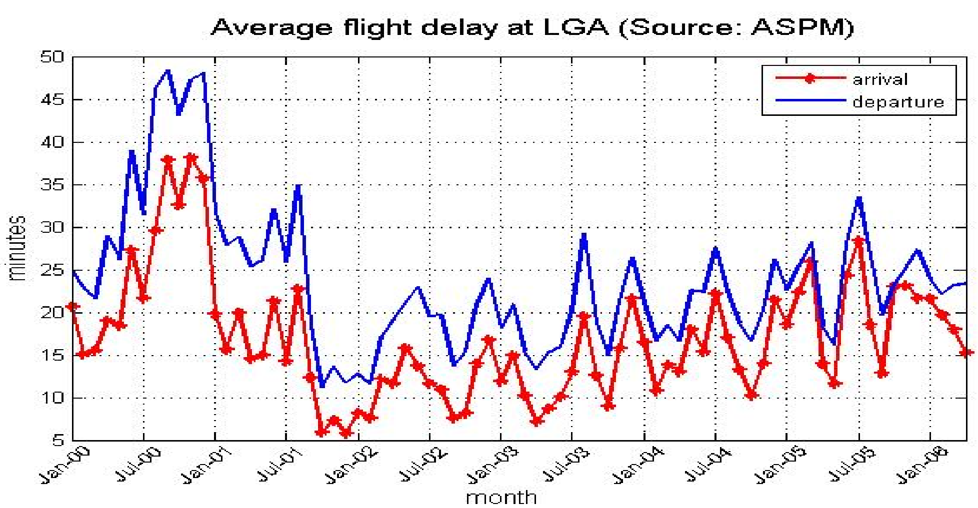

Figure 4: Arrival and Departure Delay from 2000 to 2006 [Le, 2006]

This data is suggestive of inefficient airport passenger movement and air traffic control inefficiency but was perhaps efficient for the airline operators. Figure 5 shows 6 months of flight load factor data versus aircraft size data for LGA in 2005. The horizontal and vertical lines are drawn at the 50% point on both aircraft seat size and average load factor. The data is taken from Bureau of Transportation Statistics. The upper right quadrant represents flights that deliver a large number of passengers per operation at high (profitable) load factors. This is certainly efficient from both an airport and an airline perspective. The lower left quadrant represents 25% of all the flights in this six-month period that delivered a small number of passengers-per-flight in aircraft that were probably not generating a profit for the airline. Ironically, the elimination of this 25% of inefficient flights would nearly eliminate all of the flight delays at LGA. We certainly would not advocate elimination of all of these flights as some are required to preserve minimal service levels to small communities. However, many have voiced concerns that the existence of such flights (at least in certain cases) indicates misuse of scarce LGA resources, e.g. see [Kahan, 2005].

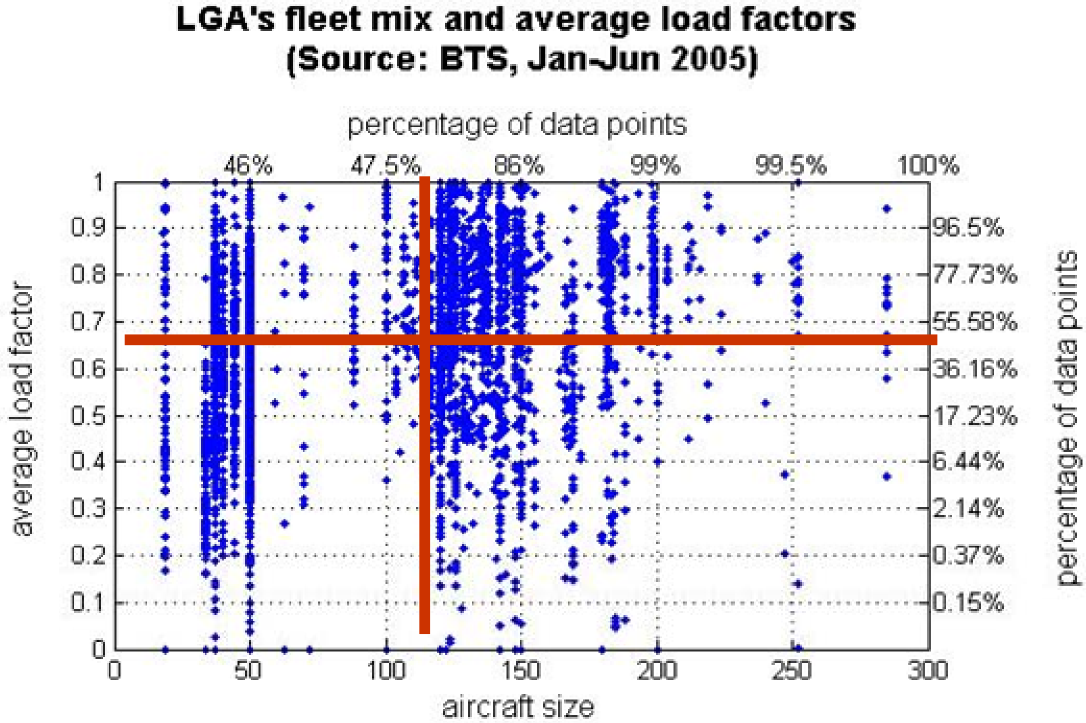

Figure 5: 25% of LGA operations are with small aircraft operating at low to negative profit margins [Le, 2006]

Is there a schedule that will satisfy all 3 definitions of efficiency: Airport Throughput, Airline Profitability and Minimal Flight Delay?. The question was addressed in [Le, 2006], where a multi-commodity flow model was used to generate an entire LGA service profile. Using real market price elasticity data for 67 daily scheduled LGA markets, Le found that 64 markets[4] could be served at 25% fewer flights that provided the airlines 90% of the optimal profit with virtually no increase in the average fare price. This schedule could be accommodated at 64 operations/hour (the FAA stated all-weather operational rate); with this flight pattern, computer delay models predict that flight delays would decrease by 75% with a corresponding increase form 95 to 121 (+27% increase) in average seats per aircraft.

4.3 Impact of Congestion Pricing on Average Gauge

The first strategic simulation was based on a plausible hypothesis regarding the level of scheduled operations at LGA for November of 2007 assuming the HDR expired and no regulation replaced it. The participants were encouraged to refrain from criticizing *specific* details of the future projection but to understand that this background was designed to provide the players with a “realistic problem” that would be *representative* of a future without any policy modifications. The participants were taken through a series of stressful decisions (without knowing how their competitors were dealing with the problems) under different hypothetical policy environments. The research goal was to better understand the pros and cons of different policy actions, up to and including conducting arrival and/or departure time slot auctions by the DOT and FAA (a mock auction was not conducted but proposed auction rules were distributed in the form of a Notice for Proposed Rulemaking (NPRM)).

The simulation proceeded through three sequences consisting of a total of five moves. Each sequence began with a baseline schedule of operations at LGA. That schedule was based on the August 2004 OAG, with flights added to bring the level of scheduled operations to a hypothetical 1400 operations per day, similar to the peak levels seen as a result of AIR-21. Each airline team was responsible for their portion of the schedule. The first sequence began with a press release announcing the passage of a Federal “Passenger Bill of Rights” law (PBR) that attempted to force airlines to compensate passengers for their delays. Per-passenger compensation was set at $10 per hour of delay and a flight cancellation was assumed to result, on

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[4] The three markets that fell out were Lebanon-Hanover, NH, Roanoke, VA and Knoxville, TN.

average, in 7 hours of delay. The first sequence continued by allowing the airline players to make schedule changes in response to the PBR.

The second sequence began again with the baseline, but then proceeded by instructing the government team to use whatever administrative procedures they felt were appropriate to handle the congestion resulting from the lifting of the HDR. The game included two rounds of applying alternative administrative actions with the airlines adjusting their schedules. The final sequence again started with the baseline, and implemented congestion pricing at LGA in an effort to reduce the costs to passengers. Two rounds of adjusting congestion prices were executed.

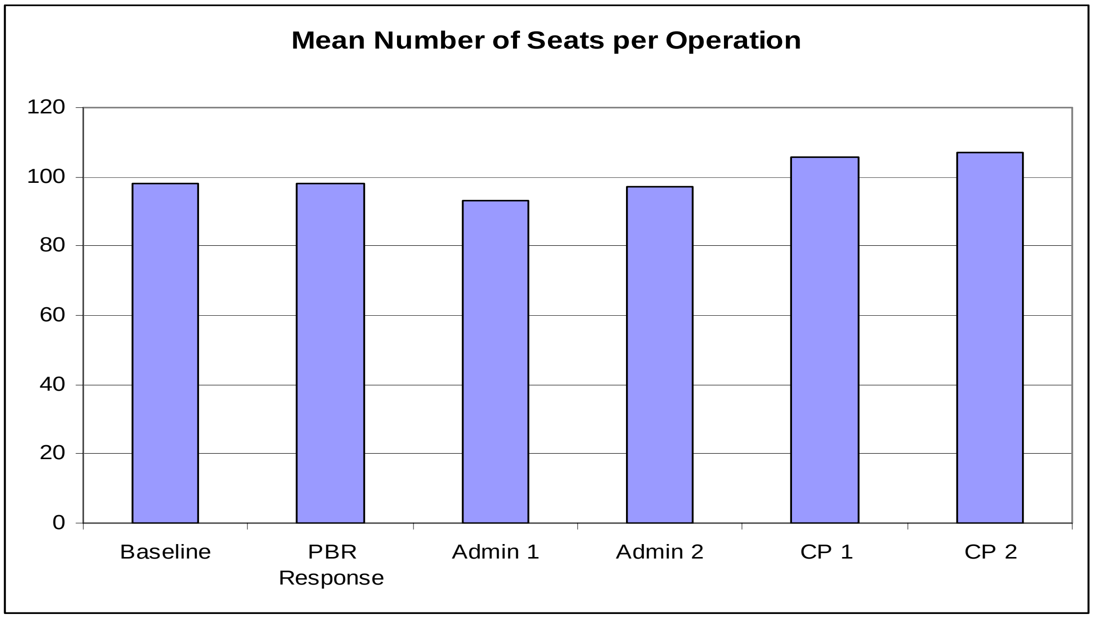

Figure 6: Aircraft Gauge Results 1st Strategic Simulation

While there are many interesting aspects to the differences in the airline scheduling behavior under the various scenarios, we would like to point out here the variation in average aircraft gauge (seats per flight). As Figure 6 illustrates, under the congestion pricing regimes, the airlines manipulated schedules in a way that led to a larger average gauge when compared to the airline response under the administrative measures. We note that under congestion pricing slots were eliminated so that there was no incentive to hoard slots or use them inefficiently (to satisfy the use-it-or-lose-it rule). As a result some of the carriers with historically large numbers of slots and operations reduced their operations. At the same time carriers with historically smaller footprints at LGA increased their levels of operations. The increase in average gauge provides some evidence that these changes led to a more efficient use of the slot resources.

More generally this result supports economic arguments that market-based allocation mechanisms, e.g. congestion pricing or slot auctions, should lead to better use of the scarce airport resources than the present administrative measures.

5. CONGESTION PRICING VS AUCTIONS

Because many otherwise chronically congested airports throughout the world are slot controlled, much of the attention in the economics literature has focused on auctions as a preferred mechanism to allocate scarce airport capacity. But, there is a potentially useful role for congestion pricing if it is implemented before the onset of congestion becomes acute.

Some of the advantages of congestion pricing are:

No Slots: With pricing, there is no need to administratively set the number of operations in a particular time period. Instead, prices would be continuously adjusted to reach desired levels of activity at the airport, with the target levels set by the FAA. The airport would be like any other except landing fees would be higher.

Carrier Scheduling Flexibility: In the absence of slots, carriers would be free to try to reduce frequencies or up-gauge in reaction to higher congestion fees knowing that they could go back later (without the need to buy a slot) and add service or reduce gauge should market conditions so dictate.

Potentially Reduced Strategic Behavior: Carriers would have no incentive or ability to hoard slots in order to prevent their competitors from having adequate access to LaGuardia. All carriers would be free to schedule flights whenever they deemed it appropriate.

There are potential disadvantages as well. These include political feasibility, the likelihood of pricing inefficiencies, strategic carrier behavior, potential scheduling instability and lack of practical experience in implementing congestion pricing. The first strategic simulation required the establishment of a politically independent Congestion Pricing Board with an analysis staff to set the congestion prices. In order to prevent severe schedule instabilities, these prices may have to be set based upon proposed schedules and computed delays.

To address these problems and avoid a potentially unstable environment, the following discussion describes congestion pricing for airports just beginning to experience delay. There are at least two keys to phasing in congestion-pricing: (1) encouraging congested airports to charge a single fee to all aircraft regardless of weight, and (2) establishing an independent Pricing Board tasked with dynamically re-setting prices to reach FAA operational targets in cases where delays continue to propagate.

Trigger for action: FAA would define a trigger when an airport is reaching unacceptable congestion.

Rationale: FAA would retain control over the integrity of the national system. In all cases, FAA would retain the right to set operations levels in the event that other actions did not reduce delay exposure to acceptable levels.

Adjustment to landing fees: To reduce the growth in delays, when an airport meets the above criteria for certain times of the day or days of the week, FAA would encourage the airport proprietor (via proprietor assurances or the competition plan process) to change its landing fee calculation methodology so that all operations pay the identical fee during each congested time period and adjacent time periods (as determined by FAA) and the total funds collected remains the same (revenue neutral flat fees).

Rationale: Traditional weight based fees provide the wrong incentives in cases where one flight precludes another. The higher fees on heavier aircraft provide incentives for operators to fly lighter aircraft. A flat fee is neutral as to weight or size of aircraft.

Independent pricing board: An independent pricing board would be established to set congestion surcharges at airports found by the FAA to be experiencing unacceptable delays.

Rationale: The Board would have only one objective, to set prices that clear the market for airport access. While it would be free to consider the views of all parties (FAA, the airport and operators), it would be judged solely on whether the prices it sets reach the operational targets set by FAA.

Surcharges: The Pricing Board would set surcharges above flat revenue neutral landing fees at airports where the actions taken in (2) proved insufficient, as determined by the FAA. The Board would be empowered to set surcharges at whatever level is necessary to reduce delays to acceptable levels.

Rationale: The Board will require the power to change prices at any time to prevent carriers from feigning entry or additional operations in the hopes of driving competitors from the market. The Board would also require carriers to publish schedules at least 90 days in advance of operation to judge potential delays; carriers would be free to adjust schedules in reaction to changes in prices up until some point after which schedules would be frozen.

There would be limits on unscheduled operations during congested periods; unscheduled operators would pay the same surcharge as scheduled operators

Switch to Slots / Auction: In cases where congestion pricing did not result in an orderly market, the FAA could implement a slot program, where access would be auctioned.

Rationale: In cases where the market was not stable, the FAA would retain the right to implement a slot program to control delays; the threat of slots might be sufficient to reduce strategic behavior by incumbent operators at the airport.

This proposal makes congestion pricing an interim step between normal market access and the implementation of slots and auctions. In at least some cases, implementing revenue-neutral flat fees or minimal surcharges may be enough to address chronic congestion for some time, thereby leaving operators greater freedom to change schedules than would be case once slots are put into place. This interim congestion pricing proposal may be particularly attractive in cases where an airport has a capacity expansion program underway and needs a relatively short period of time during which some capacity management is required to keep delays from exploding.[5]

The first NEXTOR strategic simulation held in November of 2004 provided some insight into the issues identified above. The simulation provided mixed results regarding the likely level of fees that may be needed to reach reasonable operational targets at the airport. The congestion-pricing scenario assumed that slots at LGA were eliminated and that the FAA was faced with a very large increase in operations. Table 1 provides the base case schedule (in terms of number of operations per time window) that the carriers proposed to operate after elimination of the regional jet/small community restrictions attributable to the Air 21 legislation. Two rounds of congestion pricing were executed. As Table 1 illustrates, operations did decline and there was some spreading of operations from one time period. This operations spreading did in turn create new peaks where none had existed before (e.g. 15:30).

[5] There may be important barriers to implementing congestion pricing with surcharges in the United States. The DOT and FAA "Policy Regarding Airport Rates and Charges" (Federal Register, June 21, 1996, page 31994) says in part: "The Department's policy regarding peak pricing was established in its decision in the Massport PACE fee case. In that decision, the Department concluded that a properly structured peak pricing system could be reasonable and not unjustly discriminatory. These provisions do not exempt airport proprietors from the requirement that total airfield revenues not exceed total airfield costs." It appears that current policy may accept revenue neutral fees but not revenue positive surcharges.

Beginning of Hour	Base Schedule	Round 1	Round 1 Schedule	Round 2	Round 2 Schedule
0430		$275	1	$275	1
0530	27	$275	42	$275	42
0630	75	$600	67	$600	67
0730	93	$800	66	$800	76
0830	94	$800	87	$1,000	73
0930	90	$800	71	$1,000	67
1030	84	$600	97	$1,000	96
1130	84	$600	92	$1,000	71
1230	97	$800	61	$800	81
1330	86	$800	63	$800	80
1430	84	$600	85	$1,000	71
1530	83	$600	101	$1,000	101
1630	85	$800	62	$1,200	54
1730	89	$800	86	$1,200	82
1830	92	$800	94	$1,200	81
1930	91	$800	73	$800	85
2030	81	$600	80	$600	79
2130	58	$600	36	$600	39
2230	25	$275	38	$275	38
2330	10	$275	8	$275	8
All Other	0	$275	0	$275	0
Total Operations	**1,428**		**1,310**		**1,292**

Fees are in-lieu of existing departure fees

Table 1: Results of Congestion Pricing Experiment

Obviously, the simulation pertains to a situation where an airport transitions from slots to congestion pricing. This is a far more difficult mission than would be faced by an airport just beginning to have a delay problem. Nevertheless, the simulation indicates that congestion pricing is effective in reducing overall activity, even at airports with substantial pent up demand

6. SLOT AUCTION DESIGN

In principle, both congestion pricing and auctions should reach the same market-clearing price. In the case of congestion pricing, the government sets the price and the airlines set the level of travel predictability and delay. In the case of auctions, the government sets the capacity level and the airlines set the price. The use of auctions for the allocation of slots at congested airports is likely to provide a system that is efficient, i.e. produces an allocation that maximizes the benefits to the consumer and the economy by allocating them to those that can generate the greatest benefit from the use. Having a fixed lease period allows the owner of the slot to make long-term plans, and allows airlines to adjust schedules with predictable costs for that schedule. The knowledge that the slots will be re-auctioned in the future assures that the industry must actively re-evaluate the market and the value of ownership of such slots.

One argument against auctions is that they are another tax on the industry. Auctions do raise revenue, but the revenues raised are no more than a reflection of the market value associated with a scarce resource. How the revenue generated is used warrants discussion. It is our belief that the revenue can be used to help pay for the infrastructure necessary to safely administer and expand airspace use. Since such costs must be incurred somehow, one can argue that the revenues generated are in lieu of other taxes that would be required if they were not generated from the auctioning of slots. However, we note that careful auction design often works *not* to maximize the revenue from high value bidders, but rather chooses objectives that encourage new entries and discourages or disallows monopolistic control over markets. Thus, the revenue generated is a consequence of ensuring efficient outcomes but need not generate any more than the minimum necessary to do so. Unlike a tax, which typically distorts behavior in undesirable ways, the auction prices are influencing behavior in desirable ways.

The two principal uses for auctions for LGA congestion management are for the allocation of slots by the government to air carriers and for the exchange of slots between air carriers. We call the process by which the government provides slots for a specified period of time to air carriers (and possibly others) as the ***primary slot market***. We call the process by which an air carrier sells its slot rights to another carrier as the ***secondary slot market.*** The bulk of this report describes an auction design specifically geared toward the primary market. However, we intend a similar procedure to be used in the secondary market as well.

6. 1 A Primary Market for Slots Having Finite Lease Lives

There are a number of design issues that must be considered for an auction that allocates slot at airports. We first summarize our assumptions about property rights and then describe an auction design we believe is well-suited for the leasing of airport slots. (For a more complete discussion of slot property rights, see [Ball, et al. 2006], [DotEcon, Ltd. 2001].) We consider an auction that confers the exclusive use of the slot during a given time window (e.g. within a fifteen minute period) every day. For each 15-minute period, we assume that the FAA has established the number of slots that will be available for auction based on runway and landside capacities. The leaseholder of that slot is given the right to trade or sell this slot for any portion of the leasing period in a secondary market. The leaseholder also receives the corresponding rights to terminal space, e.g. ticketing, baggage and gating facilities and will pay the “going rate” for these facilities based on the current long-term contracts with the local airport authority. We assume that an auction mechanism similar to the primary mechanism is available to allow leaseholders to sell their leases periodically. We will say more about the secondary market below.

6.2 Overview of the Package Bidding Auction Design

This section describes an auction design that allows the transfer of slots through a transparent bidding mechanism whereby slots are put up for a given lease period, the auctioneer provides prices for each item and the bidders respond by bidding the number of slots within each time period that they wish to procure at that price. The auction ends when the market clears, i.e. when there is no excess demand for the slots.

The auction design we propose is an *ascending clock auction with package bidding*, in which a bidder submits bids for any package of the slots. A slot is defined to be an arrival or a departure during a given time period. This auction design is capable of handling many related items. The approach combines the simple and transparent price discovery of the clock auction (an ascending auction where multiple items are sold simultaneously) with the efficiency of a sealed-bid package-bidding final round. The auction design proposed is based on the "Clock-Proxy Auction" [Ausubel et al, 2006]. It blends the simplicity of a clock auction with a final proxy round based on ideas from [Parkes and Ungar, 2000] and [Ausubel and Milgrom, 2002].

The *clock auction* is a simple iterative auction procedure where the bidders specify the number of slots they desire in each time period at the prices announced by the auctioneer. The design allows bidders to specify a collection of slots (i.e. a business plan) and know that they will win the entire package or none of that package. Enabling bids on *packages of slots* protects a bidder against the risk of winning only a portion of the slots needed for its business plan. The prices provided in each round allow bidders to understand the cost of competition and limit their evaluation to packages that they consider most profitable and/or essential to their business.

This auction design generalizes the eBay-style online auction to accommodate multiple items, and it utilizes an "activity rule" that prevents last minute "bid sniping."[6] The auction proceeds in rounds. No item is "won" until the end of the auction. Since more than one slot will be auctioned in a given time period, a bidder specifies the *number* of slots desired in each time period at the specified price.

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[6] Bid sniping occurs at the last minute of an auction with a fixed-time ending. The purpose of sniping is to give other bidders no chance to respond to an offer to buy. Similar actions occur when a bidder prefers to not disclose the value that it places on a bid. This bidder acquires price information from other bidders but does not reciprocate since throughout most of the auction, the bidder is silent. Such bidders are often referred to as "snakes in the grass" since they do not participate throughout the auction, but "snipe" or "attack" at the end of the auction.

This auction design includes a feature known as *intra-round* bidding – the ability for bidders to provide information about slot demand between the last round and current round bid prices –to accelerate the auction process. This feature allows the auctioneer to specify larger price increments between rounds without jumping past the maximum price that bidders are willing to pay for slots. Thus, a bidder who wanted a given package at the last round prices but finds that the package is no longer profitable/desirable at the current prices has the opportunity to specify a price point in between the last round and the current round prices for which this package would remain of interest. This bid would indicate that the bidder is willing to purchase this package at any price up to the intra-round bid price. A bidder can supply up to a fixed number (specified by the auctioneer prior to the start of the auction) of intra-round package bids in each round, thereby providing the price points at which a bidder wishes to substitute one package for another package.

The concept behind intra-round bidding is to allow a larger price increment between rounds without jumping past the maximum price that bidders will pay for slots. The auctioneer announces start-of-round and end-of-round prices and the bidders can provide "price points", implying linear combinations between the beginning and ending prices, and specify a preferred package at the implied prices. For instance, assume that the beginning price for a given time period is $10 and the ending price is $20. Between $10 and $13.99, the bidder wants 4 slots. Between $14.00 and $16.50, it wants 3. And any price between $16.51 and $20.00, it will accept 2 slots. This bidder would then provide three bids: one at the beginning price, one at $14.00 and one at $16.51. If there is more demand for this item than supply at the $20.00 price, then the starting price in the next round is $20.00 and the ending price is somewhere above $20.00, determined by the auctioneer. If, on the other hand, not all items sell at $20.00, then the auctioneer determines at what price all items clear and announces that price as the starting price of the next round. Intra-round bidding and other practical aspects of implementing clock auctions are described in greater detail in [Ausubel and Cramton, 2004].

At the end of each round of the auction, new bid prices for the next round are computed. The prices will increase on arrival and departure slots where aggregate demand exceeds the supply, and the bidders will again be given the opportunity to specify desired slot quantities at the new prices. Prices increase as a function of the amount of excess demand for the individual slots. The price of a package is then determined by summing the unit prices for each of the slots that make up that package. The auctioneer announces the total number of bids (aggregate demand) for all slots within each time period and the new prices of the slots. This process is repeated until either the auction closes naturally when there is no excess demand for slots in any time period or can be stopped by the auctioneer when total auction revenue increases by less than a target figure in two successive rounds, at which point a "last and best round" is declared. If the auctioneer declares a *last and best round*, these bids must comply with the activity rule but unlike bids earlier in the auction, the bidders can provide final bid prices that exceed current end prices. The auction will close with the final allocation that maximizes revenue given these final bids and all bids in previous rounds. However, rather than forcing bidders to pay the price bid, a procedure is employed (called a "proxy auction mechanism") that assures that the winning bidders pay only the minimum required to overcome the non-winning coalitions of bidders. Thus, as with a proxy bid in an eBay auction, the winning bidder pays the lowest price that prevents another bidder from winning, rather than paying its maximum bid amount. As a result, the identity of the winning bidders remains the same; only the prices that they pay are affected. For a complete description of the underlying economic properties of the proxy auction, see [Ausubel and Milgrom, 2002].

` At the end of the auction, winners will be announced. All winners will be required to provide payment of the total bid price within 30 days of the end of the auction. A bidder who defaults on payment will be assessed a default penalty equal to a given percentage of the bid price or the difference between the bid price and the bid of the highest losing bid on that slot, whichever is higher.

A well-functioning and transparent slot auction needs rules that make the early bidding in the auction meaningful and that discourage last-minute bidding. In familiar on-line auctions such as eBay, a bidder has an incentive to place bids in the final seconds of the auction, to conceal the bidder's intentions (sniping). In order to avoid this problem, the clock auction phase utilizes an *activity rule* that requires bidders to bid for minimum quantities of slots at the beginning of the auction in order to continue to be eligible to bid for equivalent quantities at the end of the auction. A bidder's initial activity is based on an advance deposit intended to assure that bidders complete the purchase of slots they win in the auction. Such upfront deposits are typically 5-10% of the final prices anticipated in the auction. To maintain this activity, the bidder must continue to bid for a reasonable quantity of items for which they provided upfront payments. When they fail to do so, their future activity will be limited by these actions. Thus, the activity rule is designed to make the bidding in early rounds meaningful and to provide bidders with incentive to represent truthfully their demands. This is important for a well-functioning auction, because useful price-discovery requires sincere and early bidding by all parties. This auction design has a number of positive features. The present auction design is related to simultaneous multiple round auctions used by the Federal Communications Commission (FCC) for spectrum licenses. Although these auctions have been quite successful and have been adapted to many other applications, the present auction design makes a number of improvements over the previous designs:

1. Enabling bids on packages of slots protects bidders against the risk of winning only a portion of the slots needed for its business.
2. The auction groups functionally equivalent slots into fungible classes, thereby expediting the auction – in this case, all arrival slots in a given time period are considered fungible;
3. The auction design limits the amount of non-essential information provided to the bidders, thereby reducing potential problems of collusion and retaliatory bidding. Price and demand information are provided to the bidders after each round, but information about the specific behavior of particular bidders is not provided;
4. Bidders have the ability to specify packages at prices in-between the last round and the current round informing the auctioneer that they are willing to pay up to some price that is less than the price announced by the auctioneer.
5. There is an activity rule called the *revealed-preference rule* that forces bidders to bid in a manner consistent with profit maximization.
6. Bidders will be responsible for paying for these slots at the conclusion of the auction and, if a bidder defaults, there will be a penalty assessed for such actions. Thus, bidders must be sincere in their offers throughout the auction process.

For the strategic simulation held in February 2005, we needed to provide an example of how the general design might work. We instructed the participants of this game to consider these specifics as illustrative and set by the researchers rather than by the FAA. For the game, we set the total number of arrival/departure slots per fifteen minute period to be equal to 8. (Consistent with FAA policy, we left one slot per fifteen minute period available to general aviation.) We assumed that slots would have a lifetime of 5 years and that the initial lease lengths would be staggered so that each year approximately 20% of the slot leases would expire. The initial allocation of slots was based on current incumbency rights, and, in order to initiate the process, the remaining lifetimes on slots were staggered. An additional transition increment was added to each lease lifetime. We assumed a transition increment of 2 years for the game. Thus, approximately 20% of the initial slot allotments had a lifetime of 7 (2+5) years, 20% had a lifetime of 8 (3+5) years, etc. In the initial allocation, the lifetimes of the slots allocated to each carrier were uniformly distributed among all of the slots owned by that carrier. The players understood that there would be a transparent secondary market for slot sales, held quarterly. All sales of slots by leaseholders were to be made on this secondary market. They were to consider the secondary market to be identical to the primary market from the buyer's perspective (i.e. there would be no difference in lease rights whether the prior owner was the FAA or an airline). For the initial 1, 2, or 3 years, there would only be a secondary market.

The strategic simulation took place over two days. In order to simplify the bidding, we defined a slot to be both a landing right and a take-off right at LGA, bundled together. The time specified was an explicit landing time together with an implied take-off time, i.e. the purchase of the slot allows the airline also to schedule a departure at any time within 1.5 hours after the arrival. The clock-proxy auction design accommodates the separation of arrival slots from departure slots, in the event that the industry finds this separation more desirable. Airline executives, representatives of the PANYNJ, FAA employees, and researchers participated in the mock-auction. We believe that the participants found the exercise useful. The discussions that followed the game were extraordinarily fruitful in moving our research forward. For example, the PANYNJ was concerned that up-gauging of aircraft might create ground capacity problems. [Wang and Klein, 2006] performed detailed simulations of the ground operations and found that the airport could accommodate the larger planes. Similarly, the simple approach used for allocating slots (using draws from a uniform distribution) created allocations where larger airlines were provided with slots that were bunched either toward early or toward late expiration dates. [Ball and Zhong, 2006] devised a new algorithm that eliminated this problem. Finally, the industry asked whether there were decision support tools that could help them in determining their bids. [Harsha et al., 2005] have been developing such tools.

Thus, the strategic simulation demonstrated the feasibility of an auction approach, educated various members of the aviation community about auction use, helped the researchers better understand features of the design, and helped direct future research of the NEXTOR team.

6.3 Relationship of Primary Market to Secondary Market

We now describe how the secondary and primary markets interact. We are proposing a ***transparent secondary market***, one all carriers must use to buy or sell slots. There will be no other mechanism for the sale of such slots. Thus, sales of slot lease authorizations will be permitted only through the blind market overseen by the FAA. The restriction of sales to the slot auction will ensure that all carriers have an equal opportunity to purchase slots. No subleasing will be allowed. However, carriers are permitted one-for-one exchanges of slots so long as no additional consideration is provided. These exchanges must be publicly disclosed and can take place outside of the blind market because many of these arrangements are for operational reasons and can be accomplished only through multi-carrier trades. Such exchanges would be an effective way to deal with variations in seasonal demand. However, such slot exchanges must have received written approval of by the FAA.

A secondary auction will take place every three months. The slots available during any auction will be those that have been placed into the auction by current leaseholders and by the FAA. If the slots are submitted by a leaseholder, then the FAA will augment the lease period so that the buyer will have use of the slot for the standard period. Thus, the secondary auction and the primary auction (new slots offered by the FAA or slots that have reverted to the FAA) will be intermingled with the slots offered by sellers. During the first few years, most slots submitted for auction are expected to be those offered by sellers.

Carriers having arrival or departure rights at LaGuardia may place such rights up for sale in the quarterly auction. Those purchasing these lease rights will be under the same rules and fees as those imposed upon the seller. When a carrier puts a lease up for sale, the carrier agrees to work closely with the PANYNJ to provide access to gates and other ground facilities. A buyer of slots must put up an advance deposit to ensure that such bidders are capable of paying for the slots won. Such upfront deposits are typically 5-10% of the largest price bid on any package within the auction.

The FAA will collect such offers to sell and alter the lease life of such offers so that each lease up for sale will have a ten-year life. The seller and the FAA will share the amount received from the sale of the slot proportional to the time each had ownership of that lease. The only consideration permitted for transactions in the auction is cash. Use of real property such as gates, non-monetary assets or other services in lieu of cash is not permitted.

Any carrier may participate in the secondary market as a buyer. However, a seller selling an arrival lease (departure lease) at a given period cannot buy an equivalent arrival (departure) lease in the same period. The seller has the right to specify a reserve price and the lease will not be sold unless a buyer is willing to procure the lease at a price equal to or greater than the reserve price.

If a seller finds that there are no buyers for a slot he wishes to sell, then the buyer can – at any time – relinquish ownership of the slot and the slot will revert to the FAA.

The auction design and rules for the secondary slots are the same as those for the primary auction. We are proposing that the FAA use a clock-proxy mechanism.

6.4 Advantages and Disadvantages to the Use of Primary and Secondary Markets for Slot Allocation

The advantages of auctions to control congestion include: (1) Congestion is controlled because the slot allocation was set to insure appropriate use of runways and ground facilities; (2) The initial allocation is based on incumbency and provides a transition period for the airlines to adjust to this new allocation mechanism; (3) Limited slot lifetimes and use of market mechanism for allocation insures slot turnover and efficient use of slots. (4) A transparent market mechanism provides the industry with information about the market value of slots and encourages the highest-valued uses of such slots; (5) The sale of leases exclusively through a transparent market places all airlines on an equal footing when attempting to procure rights at a congested airport; (7) The auction provides a new non-distortionary source of revenue that can be used to reduce distortionary taxes and fees; (8) This new source of funds can be directed toward capacity expansion; (9) Auctions have proven very successful in other government settings where they have been used to auction spectrum rights, environmental credits, power generation and distribution, and Treasury bills; and (10) Web-based tools for conducting auctions are now well-developed.

The disadvantages of an auction mechanism for slot allocation are that: (1) The transition period may lengthen the time before real changes are seen; (2) Auctions may place a new financial burden on airlines, but can be mitigated to the extent that these revenues offset existing taxes and fees; (3) The use of slots may limit an airline's flexibility in creating schedules that respond to current demand changes; (4) Auctions require that the FAA carefully specify capacities, define the rights associated with these slot leases, and determine an appropriate lifetime for slots that is neither so long that it hampers the ability of the industry to respond to market changes nor so short that their airlines find it difficult to plan appropriately and (5) There is no authorization currently for the FAA to use either congestion pricing or auctions for the allocation of slots although the FAA is currently requesting such authorization.

7. COORDINATING SLOT ACCESS WITH ACCESS TO OTHER AIRPORT RESOURCES

When one considers the possibility of a reallocation of slots among carriers at LGA, substantial issues arise with respect to the ability of LGA to handle the related changes in the characteristics of overall LGA operations. For example, it is likely that the aircraft fleet mix will change, the number of passengers passing through the terminal per day, the number of bags processed per day, etc. A second, even more problematic area is the need of carriers with new or increased slot holding to gain access to "other" airport resources, including gates, ticket counters, baggage handling facilities, etc. Probably the most substantial of these issues is access to gates.

Property ownership at LGA is a complex issue. The airport property itself is owned by the City of New York, and is leased to the PANYNJ for the purposes of operating the airport. Many of the gate and terminal facilities were built with airline funds under an agreement with PANYNJ. For example, US Airways built its own terminal building that is considerably more modern than the main (shared) terminal used by other carriers. This, building certainly would be considered an important (competitive) asset of US Airways. In such cases, the airline-investor typically obtained a long-term lease for the facilities. PANYNJ typically has 30-day revocation clauses; however, in the event of such a revocation PANYNJ would have to compensate the appropriate airline for the un-recovered investment in the appropriate facility. For this and other reasons, PANYNJ is reluctant to revoke leases. Thus, airlines can exercise strong control over such facilities making it difficult for airlines wishing to expand operations, e.g. based on new slot holdings. A further complication is that airlines naturally would want to have their gate facilities in reasonably contiguous locations. Gate facilities in different concourses would generally be undesirable, particularly for airlines with modest numbers of operations.

Historically, when new entrants have come in, or existing carriers have expanded operations, PANYNJ and the appropriate carriers have worked together to identify gate facilities usually through a variety of negotiations with existing gate lease holders. Of course, carriers have made deals directly with one another, e.g. to buy or sell leases and also through sub-leasing. It is certainly the case that rapid large-scale changes in access to gate facilities would be challenging, if not impossible. On the other more gradual changes probably can be accomplished. Nonetheless, this area remains a critical potential impediment to a carrier wishing to expand operations at LGA. Thus, if slot access becomes more open so that significant changes are anticipated over time, then significant steps should be taken to insure reasonable flexibility with respect to gate access. These steps might include the creation of more common-use gates and/or the creation of incentives that improve the ability of the PANYNJ to reallocate gate access.

8. THE NOTICE OF PROPOSED RULEMAKING AND CURRENT STATUS

In August of 2006, the FAA issued a Notice of Proposed Rule Making (NPRM) [Federal Aviation Administration 2006] that addressed congestion management at LGA after the expiration of the HDR. The NPRM specified that the existing slots would be replaced with operating authorizations (OA's). Each OA would have an expiration date defined so that the lifetimes varied between 3 and 13 years, i.e. after 3 years approximately 10% of the OA's would expire per year. The OA's are to be initially allocated in a way that is consistent with existing operator slot holdings. The manner in which expired OA's would be reallocated is left unspecified but the NPRM indicated a desire on the part of the Federal Government to explore the use of market mechanisms. The NPRM also included an incentive structure meant to encourage the use of larger aircraft. Specifically, average aircraft gauge goals would be set; holders of OA's that fell below the gauge goals would be subject to forfeiture of OA rights. The FAA could then either eliminate that OA thereby reducing airport demand (and congestion) or could reallocate the OA using a to-be-determined procedure. The NPRM specified certain possible exemption policies that would allow the use of smaller aircraft (that did not meet the gauge goals) for service to small communities. No final rule-making has been issued. Since the HDR authorization expired on January 1, 2007, an interim rule was put in place that largely preserved the HDR status quo. The move toward finite lifetime OA's as well as the intention expressed to explore market mechanisms would seem to indicate a interest on the part of the Federal Government in considering types of approaches described in this paper.

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