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ABSTRACT

During the late 1960s congestion often leading to long delays was common at major U.S. airports. To handle this problem the FAA set quotas on the number of flights per hour, and the CAB established committees of airline representatives to allocate the scarce landing rights among competing carriers. Currently the committee process has become a focal point of controversy: industry spokesmen have advocated that the system be expanded nationwide to handle developing congestion problems while others have attacked the committee process as being possibly anti-competitive and thus inconsistent with the goals of airline deregulation. This paper contains a description of the committee process, a theoretical model of the process, an analysis of the economic efficiency of the process, and a suggested alternative mechanism.

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During the late 1960s, air congestion often involving long delays or "stacks" was common at major airports. The right to land and take off was allocated on a first-come, first-served basis with little coordination among scheduled carriers. Since 1968, the four major airports in the United States, La Guardia, Washington National, John F. Kennedy International, and O'Hare International, have been operating under a Federal Aviation Administration (FAA) high-density ruling which limits the number of slots (takeoffs and landings per hour) at each of these airports.

Slots are allocated by scheduling committees authorized by the Civil Aeronautics Board (CAB). The scheduling committee at each airport is comprised of one representative from each airline certificated by the CAB to fly into that airport. The committees usually meet semiannually, as organized and coordinated by the Air Transport Association. Membership on the committees is relatively stable, with the same person usually being on all committees on which a carrier has representation.

The implications of the committee method of allocating airport capacity are a current policy concern. By 1985, as many as thirty-five airports may be facing serious access or capacity problems. In addition to runway, airspace, and environmental constraints, bottlenecks could be caused by loading facilities,

baggage facilities, counter space, etc. Industry sources have advocated the committee process as a national solution to the associated allocation problems.

An analysis of the committee process relevant to policy makers must overcome two difficulties. First, key data about flight and route profitability will not be released by the carriers. Second, because of recent changes, the performance of the process in the past cannot simply be extrapolated to the future. Prior to deregulation, entry was effectively blocked, so the committee needed only to coordinate a few large carriers with relatively stable shares. However, with deregulation the committee must deal with entrants that seek to alter shares.

In order to deal with these problems, we studied such data as are available, and attended four scheduling committee meetings. In addition, we conducted several series of laboratory experiments.[1] The committees studied made decisions using the same procedures as do the scheduling committees. Substantial financial incentives were used to induce demand functions which had the same qualitative properties as are thought to characterize the demand functions for slots. The experimental work graphically demonstrates that the model upon which the analysis is based has empirical support. This type of evidence will probably be of little value to economists who already have considerable experience with the behavioral properties of a variety of allocation processes. The model is typical of those which are often applied, so most economists will not be surprised to see it work in a simple laboratory environment. Nevertheless, as committee processes sometimes have subtle properties, it does not hurt to check the reliability of the basic reasoning. Furthermore, some decision makers may have no experience with game theoretic models, and rely on instincts and general theories of a completely different sort. To the extent that they may have doubts about the

generality of the economic models, additional experiments can always be conducted which incorporate the variables of their concern.

I. THE MODEL

The model applied to evaluate the committee process is the core of a cooperative unanimity voting game without side payments. Game theoretic models seem to provide the appropriate tools. It seems fair to say that members of the committee are aggressive defenders of their companies' interests and view the committee as a complicated bargaining process in which they apply all their negotiation skills. The value of a slot during peak hours could be worth hundreds of dollars a day. Members of the committee are generally individuals with important management positions within their companies and most have several years experience on the committee.[2] Evidence of strategic maneuvers is abundant.

The rule of unanimity captures much of the essence of the committee procedures. While the procedures used by the committee were not detailed in the order creating the committees, members were told to reach an "agreement." This has been interpreted as a basic rule of unanimity. In the past, the committee has always achieved unanimity and the FAA has always approved the decision. Aside from the rule of unanimity, the committee has adopted additional procedures. Prior to each meeting the members submit their requests for slots to the committee staffs. Not surprisingly, requests for slots usually exceed the FAA quotas at least for peak periods of the day. Most of the meeting is spent in discussions among carriers and with the chair, which result in reducing the number of requests to equal the number of slots available. "Sliding," a procedure whereby a carrier moves a request for operation from one hour to another, frequently occurs. Hypothetical "exercises" are often used, with carriers constrained to the

individual totals of some previous (typically the last) meeting or some other hypothetical schedule. Exercises, when complete, are usually a feasible solution which can serve as a basis for further discussion or a proposal to be voted on.

The institutional structures of the committees are designed to prevent side payments and generally induce a voting nature to the allocation process as opposed to a market nature. The committees are exempt from antitrust laws. Nevertheless, concern about potential anticompetitive effects of the committee operations led the CAB to limit the scope of the committees' activities. Each scheduling committee meeting is limited to discussions about slot allocations at a single airport for a fixed period of time. Discussions of city-pairs, scheduled fares, profitability, and other general aspects of airline competition are explicitly prohibited. Thus, for example, a committee member in the process of bargaining for an additional slot, may not mention the intended destination or point of origin. These restrictions make it difficult if not impossible for the airlines to trade slots either across the high density airports or over time. Side conversations can take place but the public nature of the bargaining situation would make any "under-the-counter" sales of slots difficult. Carriers have no property rights in slots and do not have the contractual authority to make sales or trades. Carrier A may be willing to pay carrier B for slots, but if B were to reduce its slots, some other carrier (not A) may end up with them through the committee process. Thus, the institutional features suggest a game without side payments.

In all such models the core of the game is substantially influenced by the consequences of default--the option that would prevail if the committee failed to reach an agreement. No carrier would accept an allocation which it prefers less than the default option (sometimes called the "threat point" in game theory).

Each member has the power to "block" group action and force the committee into default. Therefore, the final outcome must be at least as good as the default option for all members of the committee.

Should the committee fail to reach agreement, the decision would rest with the FAA. The procedure the FAA would use in the event of a default has not been decided. Four possibilities for allocating slots have been discussed: (1) a lottery; (2) an auction; (3) grandfathering slots according to historical patterns; (4) an administrative process of reviewing applications and applying some formula. No indication has been given by the FAA of its preference among these options, but carriers are not indifferent. The higher the likelihood that the FAA would grandfather slots, the less large established carriers would fear default. The higher the likelihood of a lottery or of the FAA giving slots to potential entrants, the less potential entrants would fear default.

II. ALLOCATIVE IMPLICATIONS

An important implication of the model introduced above is that the allocations of slots within the committee processes are sensitive to the regulatory political climate. The consequences of default depend upon the decisions of the FAA which will certainly depend on the political climate at the time of default. Thus, the evaluations of the default option which are crucial from a resource allocation perspective depend in part upon political considerations.

1. Efficiency Properties of Committee Decisions

Allocations which result from committees using procedures such as those used by the slot committees need not be economically efficient allocations. The primary variable which guides the committee decision is the threat point (consequences of default), and given its determinants, the outcomes will be economically

efficient only by accident. This general conclusion applies both at the independent committee level and at the "systems" level.

1.1 Efficiency at the Single Committee Level

The pattern has been for the new carriers to receive a few slots at the expense of carriers with a large allocation of slots. Aside from this small allocation at the time of entry, individual carriers have experienced little growth. This is understandable. Suppose the grandfather policy was adopted. The model predicts that expansion or entry could only take place if the historical time-of-day pattern was so inefficient that some carriers would prefer to give up a few slots to entrants rather than forgo the gains from trade that an entrant-induced default would cause. Thus, for practical purposes entry and expansion would be prevented. Alternatively, if a lottery were adopted, carriers could anticipate only the expected value of the lottery. Presumably this would be the number of slots divided by number of requests where "requests" are subject to some review to avoid the obvious unbounded strategy. Without further qualifications this would mean that each carrier would expect the same number of slots. The slot committee would thus unanimously choose equal division with the largest holders forced to "give-up" slots to smaller firms and entrants.

This pattern is easily seen in the experimental research. Eight (fourteen member) and ten (nine member) committee experiments were conducted with the grandfather default rule. The "historical shares" of slots across members ranged from 0 to 8 with a total of 32 and 28 units to allocate respectively. Deviations of committee allocations from historical shares averaged only .74 slots per individual per meeting and all of this is "large" holders giving up a few slots to very small holders. By comparison, three fourteen-member committees were studied under identical parametric conditions with the exception that a

lottery rule would be used upon default. All participants received either two or three slots (expected value 2.5) which is exactly the case when agents are risk neutral. Average deviation from historical share was 1.76 slots per member per meeting.[3]

The current situation is probably some mixture of these two. Thus, the largest firms should be unable to expand. In fact, the largest holders should give up slots to entrants. Entrants should obtain slots until they become dubious about the default option providing them with a reasonable expectation of more.

Again the pattern is evident in the data from the controlled environment committees. Because the initial allocations need not be related to profitability, those who should expand cannot. In the controlled environment committees, there were individuals in each size class that should have grown considerably. Growth was <u>never</u> achieved for large participants and large growth was never achieved by smaller, non-entrant participants where efficiency demanded it. Entry was always small and unrelated to underlying profitability.

Inefficient carriers should contract in size. Certainly operations should not be transferred from more profitable applications to less. Yet the latter is what can happen within committee processes. In the experiments, for example, individuals who should have received no slots according to economic criteria always got them from the committee if the default consequences were favorable.

Economics suggests discrimination among entrants. High cost carriers should not be granted scarce slots and enter the market when carriers with lower costs can enter or expand. Committee decisions on entry and exit do not follow this principle. There will be no exit since carriers whose operations should be replaced by other carriers have no incentive to relinquish their slots. There will also be no discrimination among potential entrants based upon their relative efficiency.

All entrants have equal power to default the committee and jeopardize the slots of those who have had many. Thus, with the committee, all potential entrants can "get-in." The experience of the controlled environment committees conforms to these predictions.

Given a threat point, any allocation process should exhaust "gains from trade." Generally speaking, the existing procedures are capable of dealing with that aspect of the coordination problem. The sliding operations systematically exploit the "gains from trade" from carriers trading operations at various times of day. The procedures are so natural that many controlled-environment committees initiated sliding operations even in the absence of their formal introduction. For the case of a "grandfather" default rule, efficiencies of committees that did not default always increased over the initial allocations in spite of inefficient entrants.

The sliding process does have problems. The gains from trade between two parties can be prohibited by a third member (by virtue of the unanimity rule). Thus, a member who recognizes that two other members wish to trade can use the threat of veto to gain concessions. Committee members clearly recognized this possibility in controlled-environment committees, and it appears that members of the scheduling committees also do.

1.2 System Level Efficiency

The problem of efficiency goes beyond a single airport. The value to a carrier of a slot at one airport will generally depend upon the other airports to which the carrier has access. For example, consider carriers entering a market. At a minimum this involves two airports, but because of joint costs and scale economies, entry into a "market" will frequently involve several airports. The allocation of slots within the system should be responsive to these interdependencies. The interdependencies among airports are clearly recognized by committee members.

The opportunity for some coordination across high density airports does exist. Even though discussion of city-pairs is explicitly precluded by the initial order, references are made to other meetings. Furthermore, the meetings for different airports are often convened "back to back". Nevertheless the process does not seem to deal efficiently with the interdependencies. An excellent example occurred recently when TWA waa willing to give up slots at O'Hare in order to increase its slots at National. United was interested in a "trade" but when other carriers heard slots at O'Hare might be "released" the requests for additional slots there increased accordingly and no deal was made.

The nature of the problem is easily identified in the behavior of controlled-environment committees. For one series of experiments, payments were interdependent across two meetings. In general we found no evidence that controlled-environment committees were capable of dealing systematically with the system interdependencies.

2. Responsiveness

Since the committee decisions reflect primarily the consequences of default, they do not respond readily to changed economic conditions of individual carriers; indeed, they can be perverse. For example, if the profit position of a carrier increases, the optimum response in the committee can be to make concessions on marginal slots in order to "protect" its operations from a committee default. Thus, the firm would contract as it becomes relatively profitable rather than expand as it should.

More importantly, carriers do not have an incentive to replace slots when they are "unneeded" because of short term, firm specific economics. Slots "released" and reallocated through the committee become part of the "historical share" of another carrier and thereby effect all future decisions. Even when

operations are not particularly profitable, firms have an incentive to keep them on.

3. Susceptibility to Collusion

Discussion of markets are strictly forbidden during committee meetings. City-pairs, prices, profits, etc. cannot be discussed. Yet, because of the committee structure each committee member has a type of control over competitors which is uncharacteristic of markets and inconsistent with the operation of a freely competitive system. Firms can influence the market shares among its rivals while leaving its own constant.

As an example of these considerations consider the statement of Delta, a carrier whose position at Washington National has been very stable and thus has "given up" nothing to those who are expanding.

> DL: I've got some numbers I'd like to read off. Postmeeting January, 1978, BN had 20. Postmeeting June 1978, BN had 20. Then 22, and after the meeting last summer, BN had 24. Now with four new carriers, BN asks for 4 more, all in overage hours. I don't know whether to say congratulations or shame. I don't intend to let BN get away with this. I've got people who ask me about slots not being used. I explain that it's a voluntary thing, in good will. But it's harder to explain why we don't get any. I can't explain how a carrier can go from 20 to 28 [emphasis added]. (Grether, Isaac, Plott 1979, Appendix C)

This quotation from Delta is not atypical of concerns carriers articulate about the general slot distribution. Frequently during meetings carriers will say they will reduce requests only after "others" (often named) have done so. Sometimes they are very explicit about who they feel should get what.

4. Long Run Growth

With the committee process, the value of a slot does not serve as the means and the reward for creating additional airport capacity. Instead, the slot values are capitalized in the value of the recipient carrier companies.

The committee allocation process will provide no stimulus at all for increasing airport capacity should the fiscal system fail to provide adequate funds. Or, if airport capacity is to be supplied in response to the economic demand for that capacity similar to the supply of other resources to the industry, then the committee system cannot be an adequate mechanism.

III RECOMMENDATION

The CAB should remove the antitrust exemption of the committees. In place of the committee, we recommend the FAA establish or seek legislation which would enable the establishment of one-price sealed bid auctions with aftermarkets. The timing of the auctions and the exact definition of a "slot" need further study. It may also be necessary to allow provisions for "contingent bids" to deal with possibly important complementarities and non-convexities. Revenues from the auctions should be used to relax capacity constraints. However, the exact institutional method by which the latter, important recommendation can be implemented is left for further study.

FOOTNOTES

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1. For a more complete discussion see David M. Grether, R. Mark Isaac, and Charles R. Plott, "Alternative Methods of Allocating Airport Slots: Performance and Evaluation," prepared for the Civil Aeronautics Board and the Federal Aviation Administration (Pasadena, CA: Polinomics Research Laboratories, Inc., 1979).

2. Clearly this has implications for the cost of this process. Meetings are held twice a year with all representatives present, and last about one week although time required has been increasing. A full four weeks were required in 1979 and most of this time was used in dealing with O'Hare and Washington National.

3. Using the lottery and eight grandfather experiments with identical parameters one gets $\chi^2(6) = 22.6$ which is highly significant. For this analysis, classes are defined by historical shares.