Demand Management

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Objective and Application

Help maintain efficient operations at congested airports by
• reducing total demand and/or
• shifting demand from peak to off-peak periods

“Access control”

Application involves
• use of non-capital alternatives
• mitigation in the short and medium terms
• peak-period problems

Motivation for Demand Management

• Mitigate delays which are already very large, knowing that at these levels of operation delay is extremely sensitive to even modest changes in demand or in capacity

• Other potential benefits:
  • Reduce demand surges, keeping traffic within manageable levels most of the time
  • Improved level of service
  • Reduced operational costs through more efficient utilization of available personnel, facilities and equipment

Topics

Motivation for Demand Management
Description of Fundamental Approaches
International Experience
Lessons Regarding Policies

Reference: Chapter 12
Basic Precept

- Capacity expansion should be the fundamental means for accommodating growth of demand
- Demand management should be considered only when capacity expansion becomes unreasonably expensive; or is faced by insurmountable political, social or environmental barriers
- In such cases, the forms of demand management that should be considered are the ones that interfere the least with a deregulated and competitive market

The “Do Nothing” Alternative

Allow unlimited access to airport; as delay grows, more and more aircraft operators will decide not to schedule flights; an equilibrium will eventually be reached

Problems:
- Encourages users with the lowest value of time to use the airport
- The equilibrium level of delay (and of demand) will be higher (possibly much higher) than it would have been if each operation had to pay for the marginal delay costs it imposes on others

Comparison of August Weekday Peaking Patterns: 1993 vs. 1998

Demand Management Approaches

- Administrative [Slot Allocation]
  - “Schedule Coordination”
  - Lotteries
- Economic
  - Congestion pricing (peak-period pricing, marginal cost pricing, etc.)
  - Minimum landing fees
- Hybrid
  - Slots plus peak period pricing
  - Slot auctions
  - Buy-and-sell of slots
Administrative Approaches

Based on the notion of a “slot” (= a time interval available for scheduling an arrival or departure)
Each airport has a declared number of slots per hour; this number is determined by the capacity of the most restricting element of airport
Potential allocation criteria:
  - Historical precedent
  - Stimulating competition (“new entrants”)
  - Access to new markets
  - Regular vs. occasional service
  - Size of market to be served

IATA Schedule Coordination Process

Level 1 (“non-coordinated”)
Level 2 (“coordinated” or “schedules facilitated”) (~ 75 airports)
Level 3 (“fully coordinated”)
  ~ 140 international airports (practically all busiest ones outside US)
  Coordinator appointed by appropriate authority, usually assisted by a coordination committee
  IATA Schedule Coordination Conferences (SCC); in June and November for subsequent season
  Attended by 300 air carriers, airport reps, airport coordinators, etc.

IATA Schedule Coordination Process [2]

- Air carriers must submit slot requests 27 days before SCC
- During SCC and post -SCC, coordinators resolve conflicts, finalize schedules
- Historical precedent is primary criterion
- Carriers may exchange slots
- Use-it-or-lose-it clause (80% use required)
- New entrants obtain up to 50% of “free” slots
- Several restrictive clauses re. new entrants
- Other allocation criteria: size and type of market, length of period of operation, curfews, etc.

Note: Declared capacities determined at local level

LHR Slots: Time of Day Variations

Aircraft Movements

![Aircraft Movements Chart]
Slot Availability at LHR

<table>
<thead>
<tr>
<th>Time</th>
<th>Arrivals</th>
<th>Departures</th>
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Source: Manager, Slot Coordination, Airport Coordination UK for Summer, 2000

Slot limits at selected international airports

<table>
<thead>
<tr>
<th>Airports</th>
<th>Limit of Scheduled Movements Per Interval (2001)</th>
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<tr>
<td></td>
<td>1 day</td>
</tr>
<tr>
<td>London Heathrow</td>
<td>75-85</td>
</tr>
<tr>
<td>Tokyo/Narita</td>
<td>36</td>
</tr>
<tr>
<td>Frankfurt/Main</td>
<td>78</td>
</tr>
<tr>
<td>Seoul/Incheon</td>
<td>37</td>
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<tr>
<td>Sydney</td>
<td>80</td>
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<tr>
<td>Osaka/Kansai</td>
<td>81</td>
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</tbody>
</table>

Example: Sensitivity of Delay at LHR

Source: Manager, Slot Coordination, Airport Coordination UK

Long-Term Trend: Summer LHR Slots

Source: Manager, Slot Coordination, Airport Coordination UK
Schedule Coordination Committees: Experience in USA

- Met biannually from 1969 to allocate slots at 4 “High Density Rule” (HDR) airports (JFK, LGA, ORD, DCA)
- Dept. of Transportation and of Justice observers
- Private negotiations between airlines or exchanges of slots not allowed
- Unanimous schedules approval required
- Process criticized as anti-competitive
- Impasse in deregulation era; abandoned in 1985
- Buying-and-selling of slots at HDR airports in effect since 1985
- HDR under strong challenge currently

Congestion Pricing: A Key Observation

The marginal congestion cost associated with an airport user has 2 components

-- Cost of delay to that user (internal cost)
-- Cost of additional delay to all other users (external cost)

- At congested airports, this second component can be very large -- often much more than $1000 per aircraft movement

Congestion pricing aims at increasing efficiency of resource utilization by forcing users to “internalize external costs” by paying a congestion toll

Fundamental Principle

- Optimal use of a congested transportation facility cannot be achieved unless each additional (marginal) user pays for the delay costs that (s)he imposes on all other users (Vickrey, 1967; Carlin + Park, 1970)
- Application to airports is complicated by difficult technical and sociopolitical issues
- No “pure” application exists to date

LGA: Marginal delay caused by an additional operation by time of day

- Marginal delay (Aircraft-hours) vs. Time of day of incremental operation (e.g., 5 = 0500-0559)
Marginal external delay cost per additional movement vs. average landing fee per movement

LGA: Marginal external delay cost per additional movement vs. average landing fee per movement

**Congestion pricing: observations**

- Estimating the marginal delay cost that each additional operation causes to all other movements at an airport is central to congestion pricing.
- At non-hub airports with many operators holding a limited share of airport activity, marginal delay cost is not internalized.
- Current landing (and take-off) fees at US airports bear little relationship to true external costs.

**Possible Forms of Congestion Pricing**

Due to the many practical difficulties, the realistic possibilities for application of congestion pricing seem limited to charging *during peak periods*:

- A surcharge in addition to the weight-based landing fee
- A flat fee independent of aircraft weight (or variation thereof)
- A multiplier applied to the weight-based landing fee
- A landing fee equal to the larger of a specified minimum charge and of the weight-based landing fee

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**Source:** FAA Airport Benchmark Report, 2001, *Official Airline Guide*
### Slots plus Congestion Pricing: Landing Fees, BAA (2001)

<table>
<thead>
<tr>
<th>Aircraft weight (tons)</th>
<th>Heathrow</th>
<th>Gatwick</th>
<th>Stansted</th>
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<tbody>
<tr>
<td>MTOW ≤ 16</td>
<td>Peak</td>
<td>Off-peak</td>
<td></td>
</tr>
<tr>
<td>£ 418</td>
<td>£ 130</td>
<td>£ 310</td>
<td>£ 80</td>
</tr>
<tr>
<td>16 &lt; MTOW ≤ 50</td>
<td>£ 465</td>
<td>£ 195</td>
<td>£ 345</td>
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<tr>
<td>£ 465</td>
<td>£ 335</td>
<td>£ 115</td>
<td>£ 95</td>
</tr>
<tr>
<td>For MTOW &gt; 250</td>
<td>–</td>
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</tbody>
</table>

Apply to domestic and international flights

Note: “Peak” varies by airport (Heathrow peak: 07:00-9:59 and 17:00-18:59 GMT, April 1-Oct. 31)

### Boston (1993): Proposed Landing Fee vs. Traditional Weight-Based Fee

### Auctions

- A much-discussed hybrid approach for which there is no practical experience to date
- Possible Scenario:
  - Carriers submit sealed bids for any number of slots
  - Different amounts may be offered for different slots by each carrier
  - Final price of a slot is equal to amount actually offered or to the lowest successful bid in each time period
  - All slots are auctioned simultaneously

### Complexity of Slot Auctions

- Value an airline derives from a slot depends on what other slots it obtains
  - Landings and takeoffs
  - Alternative times for a given flight
- Network effects are also important
  - A slot at a given time at airport A may be useless without a corresponding slot at airport B
- A follow-up market may be needed to adjust auctioned slot allocations
Buying-and-Selling of Slots

- A hybrid approach: slots plus a market
- Slots are, temporarily or permanently, the property of current holders
  - May be sold, leased, borrowed against, etc.
- Slot market may be restricted
- Key question: Ownership terms and acquisition method at the start.
- Duration and terms of ownership are important in determining value of slots
- May be disincentive for capacity expansion

Proposed Demand Management Alternatives in the Case of LGA

- Three types of demand management strategies were put forward in June 2001:
  1. Congestion pricing: PANYNJ (two options)
  2. Auctions: PANYNJ (two options)
  3. Administrative: FAA (three options): e.g., “encourage use of larger aircraft”

  - In fact, all options under 1 and 2 contained strong administrative components, as well

Example: Congestion Pricing, Option B

Assumes abolition of HDR slots and AIR-21 lottery slots
Target: demand total of 78 ops per hour; possible future revisions
Toll: surcharge on top of existing landing fee; all movts. 06:00-22:00 weekdays; 06:00-14:00 Sat; 09:00-22:00 Sun

Three classes of movements:
1. Exempt from congestion fee: 80 movements per weekday that formerly qualified under AIR-21 (allocated by lottery, 2 slots per airline per round of the lottery)
2. Subject to congestion fee A: GA + all other movements formerly qualifying under AIR-21 (A = $350-700)
3. Subject to congestion fee B: all other operations (B = $700-2,000)

Two Important Lessons

- Public policy objectives (“fairness”, continuity, opportunity for new entrants, access for all operators, access for small communities) dictate use of hybrid demand management systems that combine administrative measures and market-based approaches

- The demand management systems that may eventually be implemented will have complex rules
General observations on demand management

- Responsiveness to local characteristics is essential
- Most appropriate environment for application of market-based demand management approaches:
  - (True) Demand seriously exceeds capacity
  - Non-homogeneous traffic
  - Many airlines; no dominant ones
  - Mostly non-connecting traffic
  - Significant peaking of demand profile

Conclusions

- “Do nothing” policies lead to inefficient use of scarce resources at congested airports and invite excessive demand
- No demand management approach is perfect
- Schedule coordination is widely practiced outside the United States, with increasingly sophisticated rules; it can be effective at mildly congested airports, but may seriously distort market and reduce competition at airports with serious excess demand
- Economic and hybrid approaches would seem more viable in the long run

Conclusions [2]

- Marginal delay costs per operation at peak traffic hours can be very large
- Applying congestion pricing to airports is difficult in practice and its effectiveness has not been demonstrated
- Auctioning of airport slots is largely unexplored; many practical complications exist
- Future may bring increased use of hybrid demand management systems combining use of slots, peak-period pricing, buy-and-sell and possibly other approaches