

# The economics of hubs

## A literature survey

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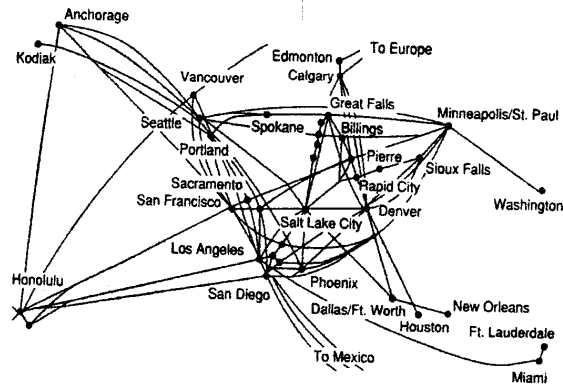
## The next 25 minutes ...

- Introduction - Characteristics and evolution of hubs
- Theoretical approaches to airline hubs
- Empirical approaches to airline hubs
- Conclusion - Unanswered questions and future thoughts

# What is a hub and spoke network?

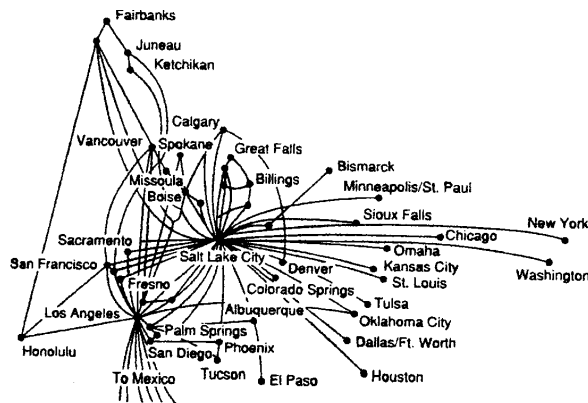
- „ A hub-and-spoke network is a route system in which flights from many ‚spokes‘ cities fly into a central ‚hub‘ city“ (Bauer (1987)).
- The term ‚hub‘ is used at two levels:
  - The role of an airport within a carrier-independent system of air transport (airport level).
  - The role of an airport within a carrier-specific network (airline level).
- Different types of HS systems can be categorized according to
  - route structure (e.g. Hinterland, Hourglass, Multiple),
  - size (e.g. primary, secondary),
  - scope (e.g. operational, marketing), and
  - strength of their local market (e.g. weak, strong).

# The evolution of hubs



## Regulated Environment

- Non-stop service dominant
- System of trunk carriers (long-haul parallel routes) and local service carriers
- (Excessive) competition between different travel ways and several quality variables
- Pricing and entry into markets regulated



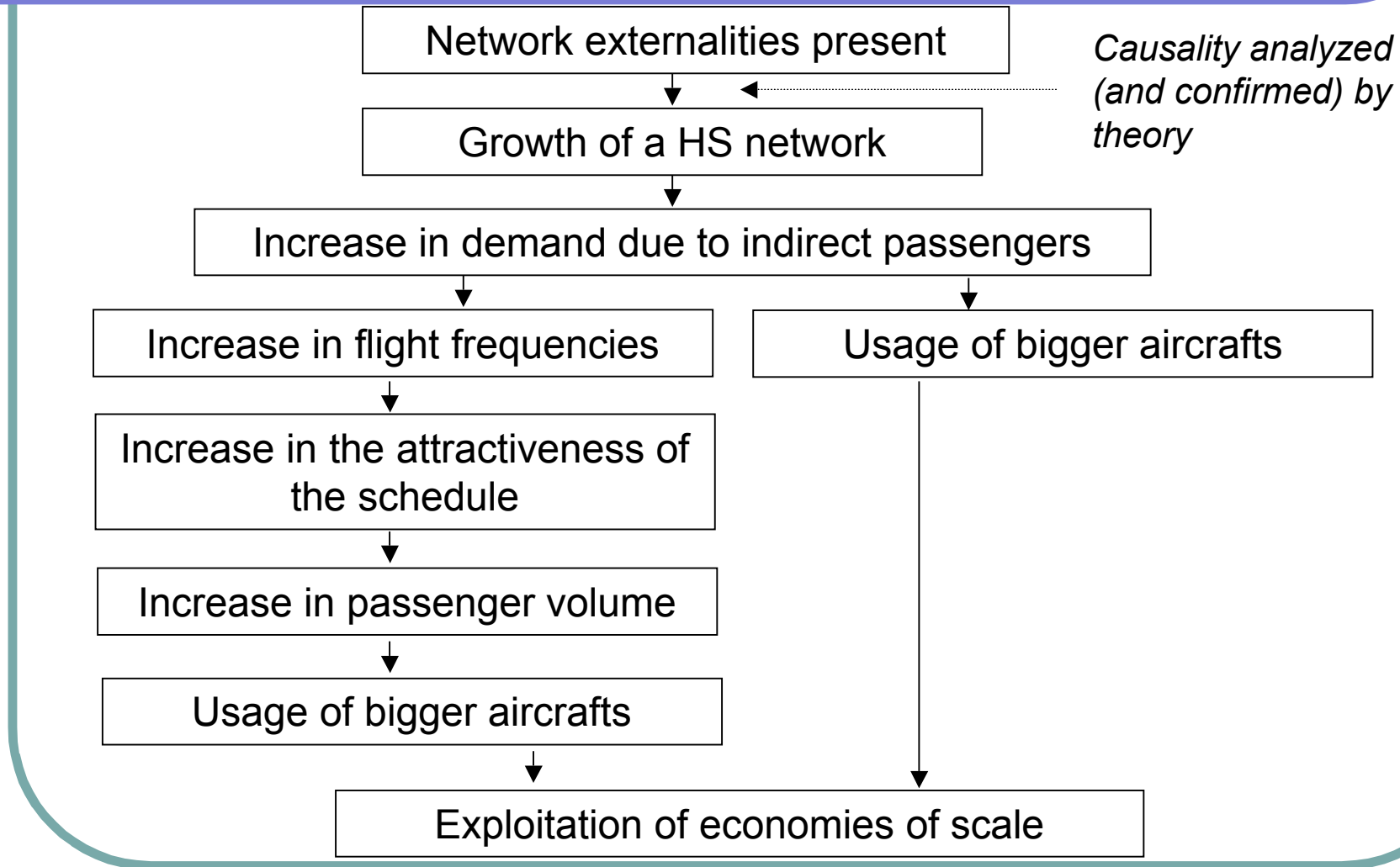
## Deregulated Environment

- HS service dominant
- Hub airport dominance
- Entry in former monopoly markets
- Technological developments
- High demand growth
- Non-stop service competitive in certain markets

# Some characteristics of HS networks

- The general effects of HS networks on airlines, airports, passengers and competition are analyzed extensively in literature, e.g.:
  - HS networks yield cost savings to the airline emanating from passenger density-economies and aircraft-size economies, as well as from a more homogenous aircraft fleet.
  - HS networks yield demand advantages for passengers, mainly due to the passenger preferences relative to price and frequency of flights.
  - HS networks increase the number of markets served by an airline.
  - Cities can be included in the flight schedule, where direct demand might be too small to justify a direct flight.
  - HS networks often lead to an increase in travel time and length.
  - HS networks increase the usage of the hub airport infrastructure in certain flight 'banks'.
  - HS networks necessarily lead to a dominance of hub airlines at their hub airport(s) (→ competition problems?).

# HS economies – a functional chain



# Theories of HS networks

- Central Questions: Why did we observe a significant increase in hubbing after deregulation and why is this increase stable until today?
- The existing theories of HS networks stem from different disciplines as
  - Operations Research (e.g. optimality of certain networks)
  - Spatial Economics (e.g. optimal location of hubs)
  - *Industrial Organization* (e.g. network structure as a strategic variable)
  - Environmental Economics (e.g. hubs and externalities)
- and find different explanations for the development of HS networks as
  - cost, demand or flexibility advantages,
  - entry deterrence and strategic competition advantages,
  - missing environmental regulations,
  - airport economics, or
  - location.

# HS networks and monopoly I

- Focusing on the field of Industrial Organization, the existing models differ in terms of
  - market structure and kind of competition,
  - cost, demand and network structure,
  - profit maximization and/or social welfare maximization aims.
- As far as *monopoly* is concerned, models concentrate on the following questions:
  - Has a monopolist airline an incentive to switch from a FC to a HS network? If yes, under what conditions?
  - How would a monopolist airline in a HS network allocate costs and set prices across city-pairs? Is such a structure sustainable in face of entry?
  - Are there incentives of ‚overhubbing‘ for a monopolist airline?

# HS networks and monopoly II

- The results indicate that
  - Marginal revenue in city-pair markets that include the hub is set equal to marginal costs on the relevant leg, and
  - in non-hub city-pair markets, the marginal revenue is set equal to the sum of marginal costs for the two legs of the trip (*Brueckner/Spiller (1991)*).
  - Simple economies of scale are not sufficient for the optimality of a HS network and
  - Ramsey prices (efficient allocation of fixed costs with respect to demand elasticities) are first-best optimal but not sustainable in the face of entry (*Bittlingmayer (1990)*).
  - Economies of density can explain the emergence of HS networks (*Hendricks/Piccione/Tan (1995)*).
  - A monopolist hub airline might choose higher flight frequencies than socially desirable (*Brueckner/Zhang (1999)*).
  - Switching to a HS network leads to increases in both flight frequency and aircraft size, while stimulating local traffic in and out of the hub

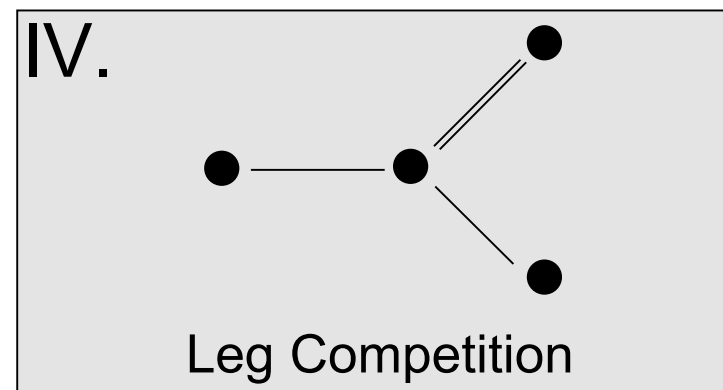
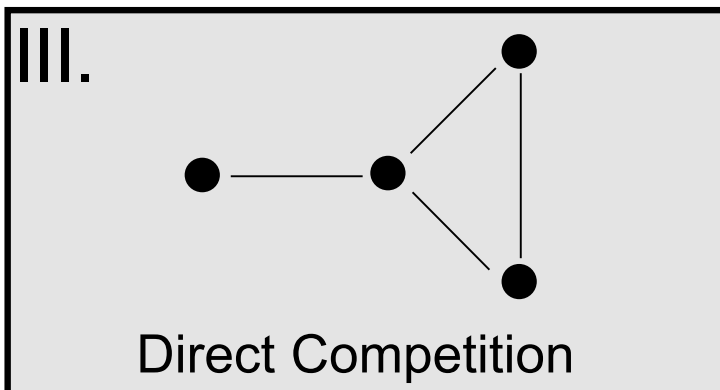
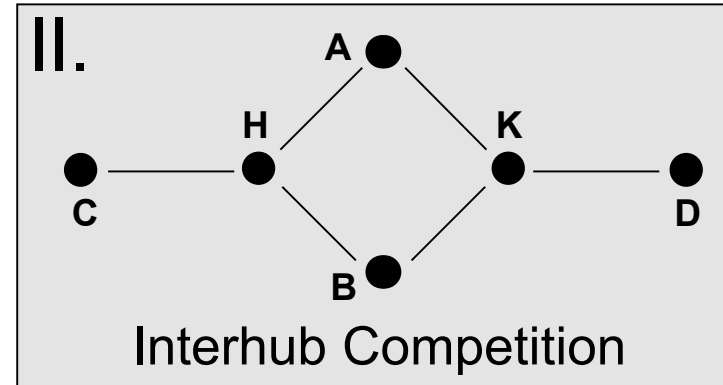
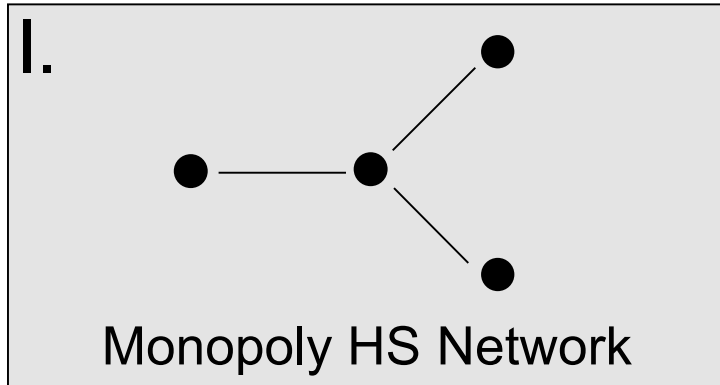
# HS networks and monopoly III

- HS networks are preferred (by the monopolist airline) when
  - travel demand is low
  - flights are expensive to operate and
  - passengers place a high value on flight frequency but are not excessively inconvenienced by the extra travel time (*Brueckner (2002)*).
- Hubbing provides a monopolist airline with increased flexibility in adjusting their capacity allocation across markets as new informations about demand conditions become available (*Barla (2000)*).
- Optimal environmental taxes (aircraft-operations- or passenger-related) would induce a reduction in the number of hub operations (*Nero/Black (1998)*).
- Capacity constraints at the hub airport may be socially desirable as they reduce excess flight frequencies (*Wojahn (2001)*).

# HS networks and competition I

- As far as *competition* is concerned, models concentrate on the following questions:
  - What are the general effects of competition in HS networks?
  - Is competition in HS networks always welfare-enhancing? If not, under what conditions is this the case?
  - Does a monopolist airline has an incentive to operate a HS network only for strategic competition purposes (e.g. entry deterrence)?
  - What are the effects of airline network rivalry?
  - Which entry strategies by local carriers are most promising (as far as accommodation by the established carrier is concerned)?

# HS networks and competition II



# HS networks and competition III

- The results indicate that
  - For the case of **interhub competition**, competition reduces traffic through the old hub H. Given the cost complementarities in HS networks, this reduction leads to an increase in marginal costs on the AH and BH legs and therefore in lower traffic and higher fares in AH, BH, AC and BC markets. Thus, interhub competition imposes a negative externality on passengers not directly affected by it. The effect in the AB market depends on the degree of increasing returns.
  - For the case of **direct competition**, competition leads to higher total traffic and lower fares in market AB in comparison to monopoly. City-pairs AC, BC, AH, BH, CH also benefit from direct competition when increasing returns are weak and demand is strong.
  - For the case of **leg competition**, competition leads to higher total traffic and lower fares in the AH market in comparison to monopoly.

# HS networks and competition IV

- In markets AB, AC, BC, BH, CH traffic is lower and fares are higher (*Brueckner/Spiller (1991)*).
- Cost complementarities can deter (regional) carriers from entering, because the hub operator can credibly threaten to maintain its presence in the spoke market even when it suffers losses (*Hendricks/Piccione/Tan (1997)*).
- By shifting to a HS network an incumbent airline can prevent stiff price competition with the entrant (due to product differentiation) (*Berechman/Shy (1998)*).
- Network choice (in a duopoly with three cities) has the potential to create strategic advantages over FC networks (a so-called 'top-dog' overinvestment strategy), but
- if both airlines operate a HS network they could create a prisoner's dilemma with reduced profits for both airlines (*Oum et al. (1995)*).

# Regions differ in number and size of hubs

- Number:
  - AUS/NZ and Canada: few; # declining
  - EU: several; # increasing
  - USA: many; # constant
- Size:
  - „AUS/NZ and Canada: small (< 39 destinations)
  - EU: size differs
  - USA: size differs; more than a dozen  $\geq 70$  destinations

- Network concentration:

GINI	AUS/NZ	Canada	EU	USA
1999	.4277	.4033	.5331	.5727
2000	.4386	.4011	.5511	.5857
2001	.4481	.3873	.5541	.5921
2002	.4360	.4000	.5557	.5854

## Hubs are not important to all carriers

- Region: AUS/NZ (-), Canada (-), EU (-) => USA (+)
- Airline type: Global (+), LCC (-), Holiday charter (-)
- Firm objective: Regional market share (+), yield (+)
- Firm size: (+)

# Determinants of location and size of hubs

- Climate (-): Likelihood of snow, fog, thunderstorm
- Market size (+)
- Inhabitants' income (+)
- Business/leisure centre (+)
- Potential to expand airport capacity (+)
- Good geographical location (+)
  
- How to measure size: # flights, # destinations, # gates?
- Re. # gates:
  - inhabitants income (+), business activity (+), geographical location (+), # intl. services (+)
  - # and size of competing hubs (-)

# Effects on hub operator

- Reduces costs?:
  - Economies of scope
  - Traffic density
  - Large network required to exploit the above
- Increases revenues:
  - Yields
  - Demand (new and via market share)
  - However, compensating factors
- Facilitates entry by hub operator, but potential exit hurdle and reduction in scheduling flexibility
- Shelter from entry, eases retaliation
- Abnormal stock market returns

# Effects on passengers

- Frequency
- Travel time
- Unclear whether and why it affects fares („hub premium“):
  - Frequency advantage leads to higher fares
  - Lower fares due to time disadvantage
  - Spoke-to-spoke fare  $< 2 * \text{spoke-to-hub fare}$
  - Increases price dispersion
  - Business vs. leisure travellers
- Unclear whether it affects choice of carrier

## Effects on competition

- No price umbrella
- Reduces financial success of rivals
- Discourages entry of rivals / Entry barrier
- However, consider competition between HS-networks

# Unanswered questions

- Net benefits of hubbing to society (and operator?)
- Why entry barrier?
- Motives for hubbing
- Evidence outside US-markets

# Some thoughts on the future of hubs

- European airline managers assess less important in 2001 than in 1998
- Threats to the advantage of hubbing:
  - Market growth
  - Technological innovations
  - LCCs / other transport modes
  - Congestion
  - Noise / emissions
- Markets to be served:
  - Primary
  - Secondary
  - Small - small

Thank you very much for your attention!

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