Airlines-within-airlines strategies and entry of Low-cost carriers

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After airline deregulation, low cost carriers (LCCs) entered the markets, e.g., Southwest, American West, Frontier, Jetblue... One interesting aspect: LCCs entered in non-hub city-pairs ("rim" routes).
Entry on hub city-pairs (spoke route)

Entry on non-hub city-pairs (rim route)
Entry routes by **Southwest**

By Bamberger and Carlton 2006

Total ## of entry on Hub City-pairs: 52 only

Total number of entry on Non-hub city-pairs: 495
Entry routes by other LCCs
By Bamberger and Carlton 2006

Total ## of entry on Hub City-pairs : 374

Total number of entry on Non-hub city-pairs : 906
1. Intro. A-in-a strategies

- Hub-spoke carriers establishing “low cost, no frills” divisions to meet LCCs those entered their rim routes.

[airlines-within-airlines strategy]

in U.S.: major carriers failed on Aina.

in Europe and Asia Pacific: carriers are now adopting the A-in-a stra.
## 1. Intro. Examples in US

<table>
<thead>
<tr>
<th>Major carriers</th>
<th>Delta</th>
<th>United</th>
<th>Continental</th>
<th>Delta</th>
<th>US Airways</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-cost, nonstop division</td>
<td>Song</td>
<td>Ted</td>
<td>CALite</td>
<td>Delta Express</td>
<td>Metrojet</td>
</tr>
<tr>
<td>LCC rivals</td>
<td>JetBlue</td>
<td>Frontier, America West</td>
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</tr>
</tbody>
</table>
## 1. Intro. in EU/Asia Pacific

<table>
<thead>
<tr>
<th>Major carriers</th>
<th>British Airways</th>
<th>Qantas</th>
<th>Iberia Airline</th>
<th>Thai Airways</th>
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</thead>
<tbody>
<tr>
<td>Low-cost, nonstop division</td>
<td>OpenSkies</td>
<td>Jetstar</td>
<td>Jetstar</td>
<td>Clickair</td>
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<td></td>
<td>NY-Amst.</td>
<td></td>
<td></td>
<td>Bangkok-Singapore</td>
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<tr>
<td>LCC rivals</td>
<td></td>
<td></td>
<td>Vueling Airlines</td>
<td>Value Air, Tiger Air</td>
</tr>
</tbody>
</table>
Many examples in Dunn (2008) & new examples in this paper!!
1. Intro. Carriers’ concerns

interesting trade-off:

**Merit:** has cost advan.to comp.with LCCs.

**Demerit:** cannibalizes network carries’ pi

- Is the A-in-a stra profitable for major carriers?
1. Intro. Anti-comp. concerns

- Two complaints to DOT.
  Valujet complained US airways:
  Air south  Continental:

- DOT suggests the A-in-a stra. are difficult to explain as non-predatory.
1. Intro. Previous studies

- Morrell (2005) JATM: cost comparison analysis
- Dunn (2008) IJIO: empirical study

No existing study addresses the issue of A-in-a stra and LCCs’ entry theoretically.
1. Intro. Dunn’s main results

A hub-spoke network carrier

Network carriers’ own one-stop service (or their rivals’) is low quality

Less likely to enter/adopt

More likely to enter/adopt
1. Intro. Dunn’s main results

A hub-spoke network carrier

Hub-spoke network carriers

Less likely to enter/adopt

if non-stop rival exists

More likely to adopt
1. Intro. Paper’s purpose

Theoretically investigate profitability of Aina stra., relevant impacts on LCCs.

Focus and features:

- entry of LCCs
- adoption of A-in-a stra:
  - establish a low cost nonstop division
- flight frequency com.
Network for Case-e: nonstop LCCs rival entered

- Operating costs per flight: K1

- Nonstop LCC rival entered

- LCC rival’s operating costs per flight: K2
Network for Case-aI offering $q_{AB}^1$

Case-aII withdrawing $q_{AB}^1$

Operating costs per flight: $K3$
2. Model. Utility function

- $w$: will to pay, uniformly distributed $[-\infty, W]$
- Symmetric AH, BH spoke markets
  \[ u_j = w + (f_j^1)^{1/2} - p_j^1, j = AH, BH \]
- Connecting AB market (hub-through extra cost: $T$)
  \[ u_{AB} = \begin{cases} 
  u_{AB}^{\text{nonstop}} & \text{if using Airline i's nonstop service, } i = 2,3 \\
  u_{AB}^{\text{onestop}} & \text{if using Airline 1's onestop service} 
  \end{cases} \]
  \[ u_{AB}^{\text{nonstop}} = w + (f_{AB}^i)^{1/2} - p_{AB}^i \]
  \[ u_{AB}^{\text{onestop}} = w + (f_j^1)^{1/2} - p_{AB}^1 - T \]
2. Model. Demand functions

Case-e: without $q^3_{AB}, P^3_{AB}$

Case-aI:

\[
\begin{align*}
P_j^1 &= W + (f_j^i)^{1/2} - q_j^1, \ j = AH, BH \\
P_{AB}^1 &= W + (f_{AB}^i)^{1/2} - (q_{AB}^1 + q_{AB}^2 + q_{AB}^3) - T \\
P_{AB}^2 &= W + (f_{AB}^2)^{1/2} - (q_{AB}^1 + q_{AB}^2 + q_{AB}^3) \\
P_{AB}^3 &= W + (f_{AB}^3)^{1/2} - (q_{AB}^1 + q_{AB}^2 + q_{AB}^3)
\end{align*}
\]

Case-aII: without $q^1_{AB}, P^1_{AB}$
2. Model. Cost differential

Following Brueckner & Zhang 2001, Kawasaki 2008

Air.i’s oper. costs/per direct flight: \( K_{i,i} = 1, 2, 3 \)

- \( K_i = \text{fixed cost} + \text{constant marginal cost} (\equiv 0) \)
- \( K_1 \geq K_2 \equiv 1, \ K_3 \text{ larger/smaller than k2.} \)
- Entry/establishment costs are ignored.
2. Model. Profits functions

Case aI:

\[ \Pi_1 = p_{AH}^1 q_{AH}^1 + p_{BH}^1 q_{BH}^1 + p_{AB}^1 q_{AB}^1 - (f_{AH}^1 + f_{BH}^1)K_1 + [p_{AB}^3 q_{AB}^3 - f_{AB}^3 K_3] \]

\[ \pi_2 = p_{AB}^2 q_{AB}^2 - f_{AB}^2 K_2 \]

3. Outcomes for three cases

See Table A.1, A.2 in Appendix
4. Adoption of A-in-a stra.

Lemma 1. benchmark case: $K_2 = K_3$

$\Pi_{1\text{all}} \geq \Pi_{1\text{al}}$ if $T \geq T_L^{a} \equiv \left[ \frac{2(3 - 2K_1)}{5(4K_1 - 1)} \right] W$

A-in-a strategy with Sce. II (withdraw the one-stop service) is preferable, except costs $(T, K_1)$ is small.
4. Intuition for lemma 1

Network for Case-aI

Network for Case-aII

Merit: enjoy Network Freq. Eff. by joint-production
Demerit: cannibalization effect

Merit: without cannibalization effect

(T,K1) small: Air.1 remains one-stop to enjoy NFE.
(T,K1) large: then give up NFE, derives larger profits by Air.3 with lower cost K3.
Prop. 1: $A$-in- $aI$ always $\downarrow \Pi 1$, $\uparrow \pi2$. This holds, even though $K3<<K2=1$
4. Intuition for Prop. 1

Network for Case-e

Network for Case-aI

Merit: enjoy network freq. eff. by joint-production
Demerit: cannibalization effect

establishing 3 cannibalizes 1's demand of one-stop service
→ 1 has to ↓ spokes' f1s. → f1s, q1s, ↓ Π1^{HS} ↓ > π3 ↑ ⇒ Π1 ↓
[q1ABe] > [q1ABaI + q3ABaI] ⇔ [q2ABe] < [q2ABaI] ⇒ π2 ↑
4. Effects for A-in-aI
Comparative-static analysis of K3

**Corollary 1 to Prop. 1:**
1. \( \frac{d\Pi_1}{dK_3} < 0, \frac{d\pi_2}{dK_3} > 0 \). ← transparent
2. \( \frac{d\Pi_1^{HS}}{dK_3} < 0, \frac{d\pi_3}{dK_3} > 0 \). ← unusual

\( K_3 \downarrow \rightarrow 3 \uparrow f3AB \rightarrow \text{bring new demand into the market!} \)

However this created demand is absorbed by 1

i.e., \([f1s \uparrow \text{spokes} f1s, q1s \uparrow \Rightarrow \Pi_1^{HS} \uparrow]\)

\( q3AB \downarrow \Rightarrow \pi_3 \downarrow \)
4. effects for A-in-aII

Network for Case-e

Network for Case-aII

\[ f_{AH}^1; q_{AH}^1 \]
\[ f_{BH}^1; q_{BH}^1 \]
\[ f_{AB}^2; q_{AB}^2 \]

K2=1

\[ f_{AH}^1; q_{AH}^1 \]
\[ f_{BH}^1; q_{BH}^1 \]
\[ f_{AB}^2; q_{AB}^2 \]

K1

\[ f_{AB}^3; q_{AB}^3 \]

K3
4. Effects for A-in-a II

Prop. 2: holds when $K_3 = K_2 = 1$

Due to the A-in-a II

Reg. Z: $\Pi_1 \uparrow$, $\pi_2 \downarrow$

Reg. Y: $\Pi_1 \downarrow$, $\pi_2 \downarrow$

Reg. V, X: $\Pi_1 \downarrow$, $\pi_2 \uparrow$
4. Intuition for Prop. 2

Network for Case-e

Reg. Z (T,K1) large:
large K1 leads 1 to withdraw q1AB, to ↓ expensive f1s
large T leads 1 to shift its one-stop service to its division's nonstop service with low cost K3.
3 greatly steals 2's AB demand ⇒ π2 ↓

Reg. V,X (T,K1) small:
1 not adopt Aina, so as to enjoy large NFE. If adopt Π1 ↓, π2 ↑

Reg. Y (T,K1) intermediate:
If adopt, q1AB < q3AB → q2AB ↓ ⇒ π2 ↓, But the loss on the two spokes (the cost for giving up NFE) > π3+ ⇒ Π1 ↓
Corollary 2 to Prop. 2: $\frac{d\Pi_1}{dK_3} < 0, \frac{d\pi_2}{dK_3} > 0$. 

Region X: $\Pi_{1}^{\text{all}} < \Pi_{1}^{e}, \pi_{2}^{\text{all}} > \pi_{2}^{e}$

Region Y: $\Pi_{1}^{\text{all}} < \Pi_{1}^{e}, \pi_{2}^{\text{all}} < \pi_{2}^{e}$

Region Z: $\Pi_{1}^{\text{all}} > \Pi_{1}^{e}, \pi_{2}^{\text{all}} < \pi_{2}^{e}$

$K_3 = 3/5$
5. Conclusion - Contribution 1
implications for a HS network carrier
to meet its nonstop LCC rivals, Aina stra.could be profitable only if the HS network operating costs are suff.ly large. But importantly, has to withdraw the one-stop if it aims to enjoy NFE by remaining HS network (ie, remain one-stop service), while to seek cost advantage by A-in-a stra. then even though its division is relatively cost efficient, the stra. is unprofitable overall.
5. Conclusion—Contribution 2
with Dunn’s empirical results

Dunn (2008): it is not unusual that network carriers entering markets with nonstop service, even though they also offer one-stop service through a hub, in particular, when their one-stop service is of low-quality.

This theoretical paper: if the quality of network carriers’ one-stop service is low (e.g., the hub-through extra cost is large), then it is sensible for network carriers to adopt the A-in-a stra, but importantly it has to withdraw the one-stop service.
Previous studies showed: HS network is useful for deterring the entry on spoke markets.

This paper found that in certain circumstance the Aina stra. may hurt LCCs, implicitly implies the possibility of point-to-point network formed by Aina stra. may play a role of deterring the LCCs' entry on rim markets.

5. Conclusion—Contribution 3
new insight into airline studies
5. Conclusion - future works

- the relationship between the parent airlines and their low-cost divisions
- to consider the choices of aircraft size (the relationship between frequencies and total traffic volume)
- to consider the timing of LCCs' entry and the establishment of low-cost divisions. Using a dynamic game to explicitly investigate how Aina stra. affects the entry decision of LCCs.
Thank you for your attention ♪

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Hereafter for references
4. Intuition for Prop. 1 - note

Why $[q_{1ABe}] > [q_{1ABaI} + q_{3ABaI}]$?

- Larger $-1 + 1$

Establishing $3 \rightarrow$ hedonic price is the same
   $\rightarrow$ total demand does not change.

If $q_{3AB}$ and $q_{1AB}$ are identical $\rightarrow$

$[q_{1ABe}] = [q_{1ABaI} + q_{3ABaI}]$

-1 $+ 1$

But! Network frequency effect exist

$q_{3AB} + 1 \rightarrow q_{1AB} -1 \rightarrow f1AH(q_{1AH}) \downarrow \rightarrow q_{1AB} \downarrow$ more