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Revenue Management and Fare Structure (Some History and Some Research) And Some Thoughts on NDC

For AGIFORS RM in Panama,

Bill Brunger

May, 2019

The First Day of Deregulation (and Me)

Generally Formulaic: Highly seg-mented (stay require-ments; APs; pax types); Leisure fares always > .5 x Y fare

C. A. B. No.

Airline Tariff Publishing Company, Agent
LOCAL PASSENGER FARES TARIFF NO. PF-17

Cancels 61st Revised Pa
60th Revised Pa

CONTINENTAL AIR LINES, INC. LOCAL FARES

For the application of fare classes and the explanation of reference marks and symbols, see Pages 173 through 176.
For the explanation of abbreviations, see Pages 5 through 8.

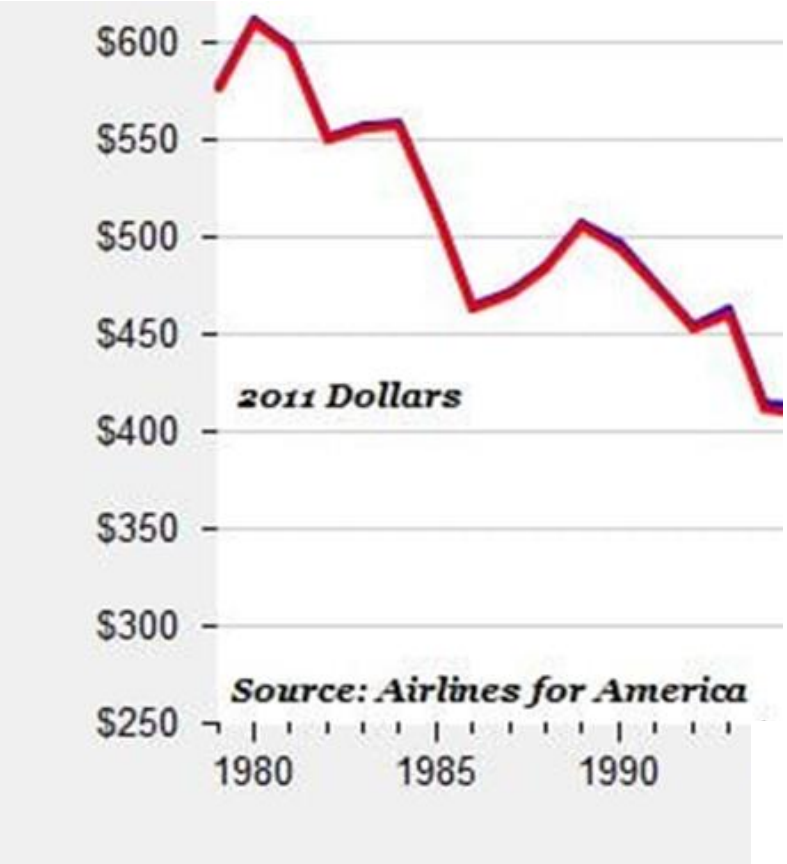
between LOS ANGELES and

FARE CLASS		LOS ANGELES RG1	LUBBOCK RG1	MIAMI/FT. LAUDER-DALE RG17	MIDLAND, TEX. RG1	MIDLAND, TEX. RG501	NEW ORLEANS RG1	NEW YORK/ NEWARK RG19	OKLAHOMA CITY RG1
F	OW	40.74	199.07	s 403.70	♦ 189.81	■ 199.07	♦ 292.59	401.85	♦ 224.07
Y	OW	♦z 31.48	♦ 152.78	♦s 310.19	♦ 146.30	■ 152.78	♦ 225.00	♦ 309.26	♦ 172.22
FN	OW	z 31.48	152.78	310.19	146.30	■ 152.78	♦ 225.00	309.26	172.22
YN	OW	♦z 25.00	122.22	248.15	116.67	■ 122.22	♦ 179.63	247.22	137.96
YM	OW	. . .	c 114.81	♦c 232.41	♦c 110.19	■c 114.81	c 168.52	e 232.41	♦e 128.70
YCHE6	RT	. . .	152.78	310.19	146.30	■ 152.78	♦ 225.00	309.26	172.22
YE6	RT	. . .	♦ 260.19	403.70	249.07	■ 260.19	270.37	401.85	258.33
YNE6	RT	. . .	229.63	341.67	219.44	■ 229.63	♦ 225.00	♦ 339.81	♦ 224.07
YE46	RT	. . .	♦ 260.19	403.70	249.07	. . .	270.37	401.85	258.33
YCHE46	RT	. . .	152.78	310.19	146.30	. . .	♦ 225.00	309.26	172.22
YWE80	RT	. . .	et244.44	c 496.30	et234.26	■et244.44	c 360.19	♦e 494.44	♦ct275.93
YXE80	RT	. . .	ct213.89	♦e 434.26	et204.63	■et213.89	♦e 314.81	e 433.33	♦ct240.74
YNE46	RT	. . .	229.63	341.67	219.44	. . .	♦ 225.00	♦ 339.81	♦ 224.07
YG18	RT	. . .	e 213.89	♦e 434.26	e 204.63	■e 213.89	♦e 314.81	c 433.33	♦e 240.74
YVUSA	OW	. . .	e 91.67	e 186.11	e 87.96	■e 91.67	e 135.19	♦e 185.19	e 103.70

FARE CLASS		PEORIA RG526	PHOENIX RG1	PORTLAND, ORE. RG10	SAN ANTONIO RG1	SEATTLE RG10	TUCSON RG1	TULSA RG1	WASHINGTON RG19
F	OW	♦ 320.37	105.56	♦ 167.59	♦ 227.78	183.33	♦ 116.67	♦ 237.04	397.22
Y	OW	♦ 246.30	♦ 81.48	♦ 128.70	♦ 175.00	♦ 140.74	♦ 89.81	♦ 182.41	♦ 305.56
Q	OW	. . .	56.48	. . .	. . .	. . .	59.26	. . .	. . .
FN	OW	246.30	81.48	128.70	♦ 175.00	140.74	89.81	♦ 182.41	305.56
YN	OW	197.22	64.81	102.78	♦ 139.81	♦ 112.96	♦ 72.22	146.30	244.44
YM	OW	e 185.19	c 61.11	e 96.30	e 131.48	c 105.56	♦e 67.59	♦e 137.04	e 229.63
YCHE6	RT	246.30	81.48	128.70	♦ 175.00	140.74	89.81	♦ 182.41	305.56
YE6	RT	♦ 320.37	♦ 98.15	♦ 180.56	262.96	197.22	♦ 152.78	♦ 274.07	363.89
YNE6	RT	♦ 271.30	81.48	♦ 180.56	♦ 227.78	197.22	134.26	♦ 237.04	325.00
YE46	RT	♦ 320.37	♦ 98.15	♦ 180.56	262.96	197.22	♦ 152.78	♦ 274.07	363.89
YCHE46	RT	246.30	81.48	128.70	♦ 175.00	140.74	89.81	♦ 182.41	305.56
YWE80	RT	et394.44	et130.56	c 205.56	♦et279.63	e 225.00	et143.52	♦et291.67	et488.89
YXE80	RT	ct344.44	♦et113.89	♦e 180.56	et245.37	c 197.22	et125.93	♦ct255.56	♦et427.78
YNE46	RT	♦ 271.30	81.48	♦ 180.56	♦ 227.78	197.22	134.26	♦ 237.04	325.00
YAP	OW	. . .	. . .	e 83.33	. . .	. . .			
YAPCH	OW	. . .	. . .	e 41.67	. . .	. . .			
YG18	RT	e 344.44	♦e 113.89	♦e 180.56	e 245.37	e 197.22			
YVUSA	OW	c 148.15	e 49.07	♦e 76.85	♦e 104.63	e 84.26	e 53.70	e 109.26	e 183.33

From June 2, 1980

The U.S. Airline Industry Has Already Experienced an Era of "Dynamic Pricing"



- In 1980, CAB*-mandated fares were very structured…
- Then the airlines experimented…
- There were unexpected consequences…
- Fares fell 30% (but LF increased…)

*CAB = Civil Aeronautics Board i.e. the U.S. Government; International Fares were similar

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What happened in the 1980s and early 90s?

Experimentation: In early '80s, some "knew" that leisure fares seemed too high, some "guessed" that business fares were too low (especially given new FFPs)

- Wild short-term sales and frantic fare wars
  - Undercutting & "Jockeying"; learning "equilibrium"
- SATUWEs; USS; Peanut Fares;… and Over-reactions
- Coupons were the "ODC"/"Dynamic Price Adjustment" mechanism. And, for some, "On-demand matching"

By the time the Airlines caught their breath, the average RT U.S. Domestic airfares was down by one third…

- But Load Factors rose so RASM/K suffered less…

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How might NDC-based Dynamic Pricing disrupt?

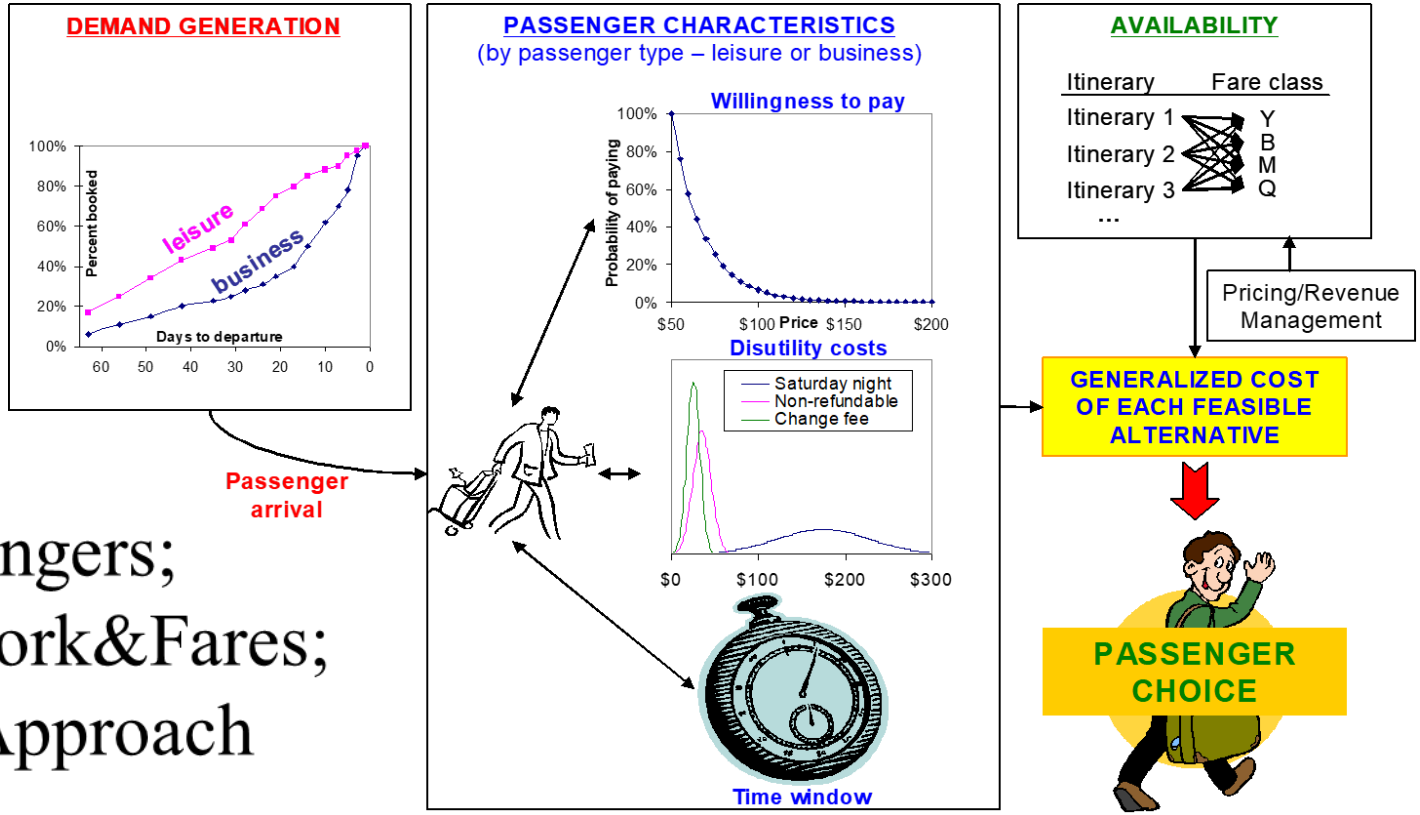
- Fare levels will no longer be "fixed" numbers; "competitive" fares become a "distribution of fares"…
- If one competitor offers discounts below the lowest fare, may destabilize the then current fare levels…
- If one competitor discounts a higher fare without maintaining terms and conditions, that might erode the fare structure…

- My 2019 Research Question:

Haven't our Revenue Management Systems become so sophisticated that they will compensate for changes in Fare Structure?

We will Use the PODS Simulator to Make Some Comparisons…

- My AGIFORS research: Impact of sophisticated RM when underlying fare structure erodes



Passengers;
Network&Fares;
RM Approach

Courtesy T. Gorin

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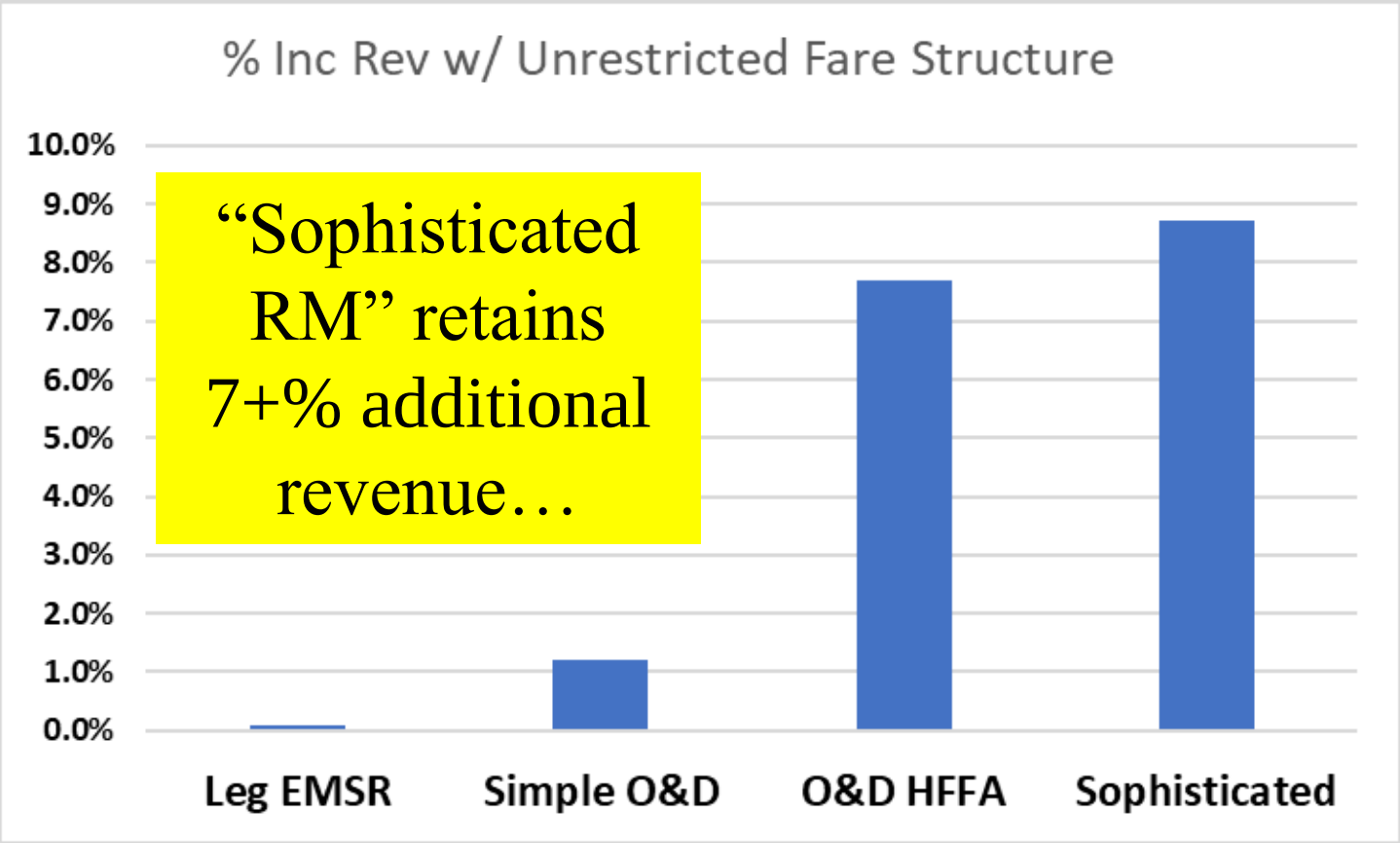
Experimental Setup

- Four airlines; "Realistic" fares; "Normal" PODS setup
  - One airline models an LCC and uses Adaptive Threshold RM
- Start with "unrestricted fares" with No AP requirements and no stay/refund/… restrictions
- Compare RM Algorithms
  - **F**irst-**C**ome-**F**irst-**S**erved as "baseline"
  - Leg-based **EMSR**
  - Simple O&D **D**isplacement **A**djusted **V**irtual **N**esting
  - Better Network DAVN with **H**ybrid **F**orecasting and **F**are **A**djustment (scaled to .25)
  - Very "Sophisticated" (**U**nbucketed **DP**,HF,FA,EM)
- (Then I will vary the **fare structure**…)

Won't "Modern" RM "Fix" Everything? Sophisticated RM when Unrestricted…

- Results vs. First-Come/First-Served:



Leg EMSR uses leg-forecast; "Simple O&D" is DAVN; O&D also using HFFA, "Sophisticated RM" is UDP w/ Hybrid Forecasting and Fare Adjustment

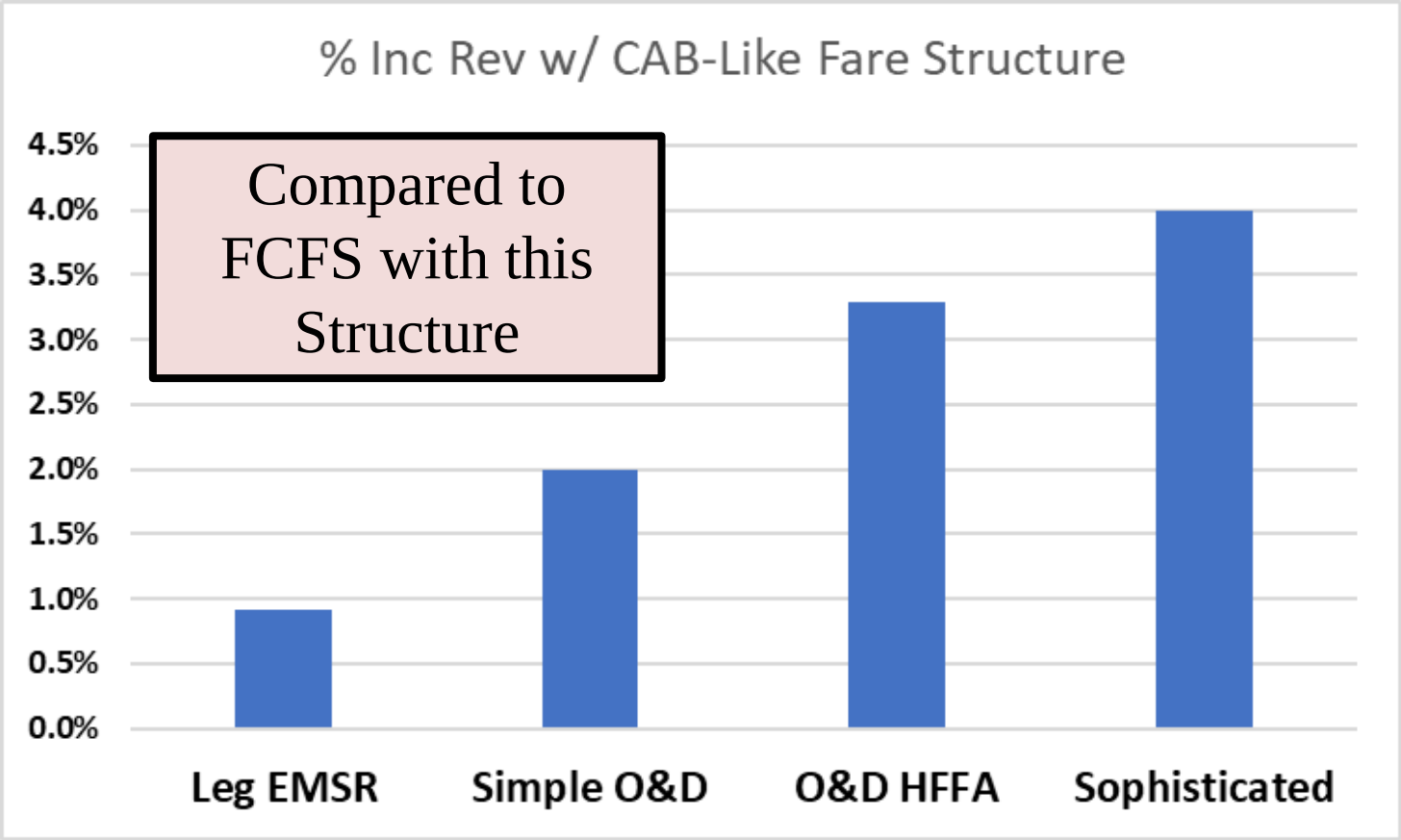
Experimental Design: Vary Advance Purchase Requirements & Restrictions

- Does "sophistication" help if we impose CAB-like restrictions? (i.e. All markets have the structure below)

Fare	**Advance**	**Sat**	**Lesser Restrictions**		
Class	**Purchase**	**Stay**	1	2	3
1	0	0	0	0	0
2	0	0	0	0	1
3	3	0	0	1	0
4	0	1	0	0	0
5	3	0	0	1	1
6	7	1	1	0	0
7	14	0	1	1	1
8	14	1	0	1	0
9	21	1	1	0	1
10	21	1	1	1	0

Is Sophisticated RM still Effective when Segmentation is Strong?

- Better RM generally increases revenue:



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A "Mixed" Fare Structure
(One third of markets have fewer restrictions)

Domestic Fenced

FC	AP	SAT	R1	R2
1	0	0	0	0
2	0	0	1	**0**
3	**3**	0	0	0
4	7	0	0	1
5	7	1	0	0
6	14	1	1	0
7	14	1	0	0
8	14	1	0	1
9	21	1	1	0
10	21	1	**1**	1

Domestic Unfenced

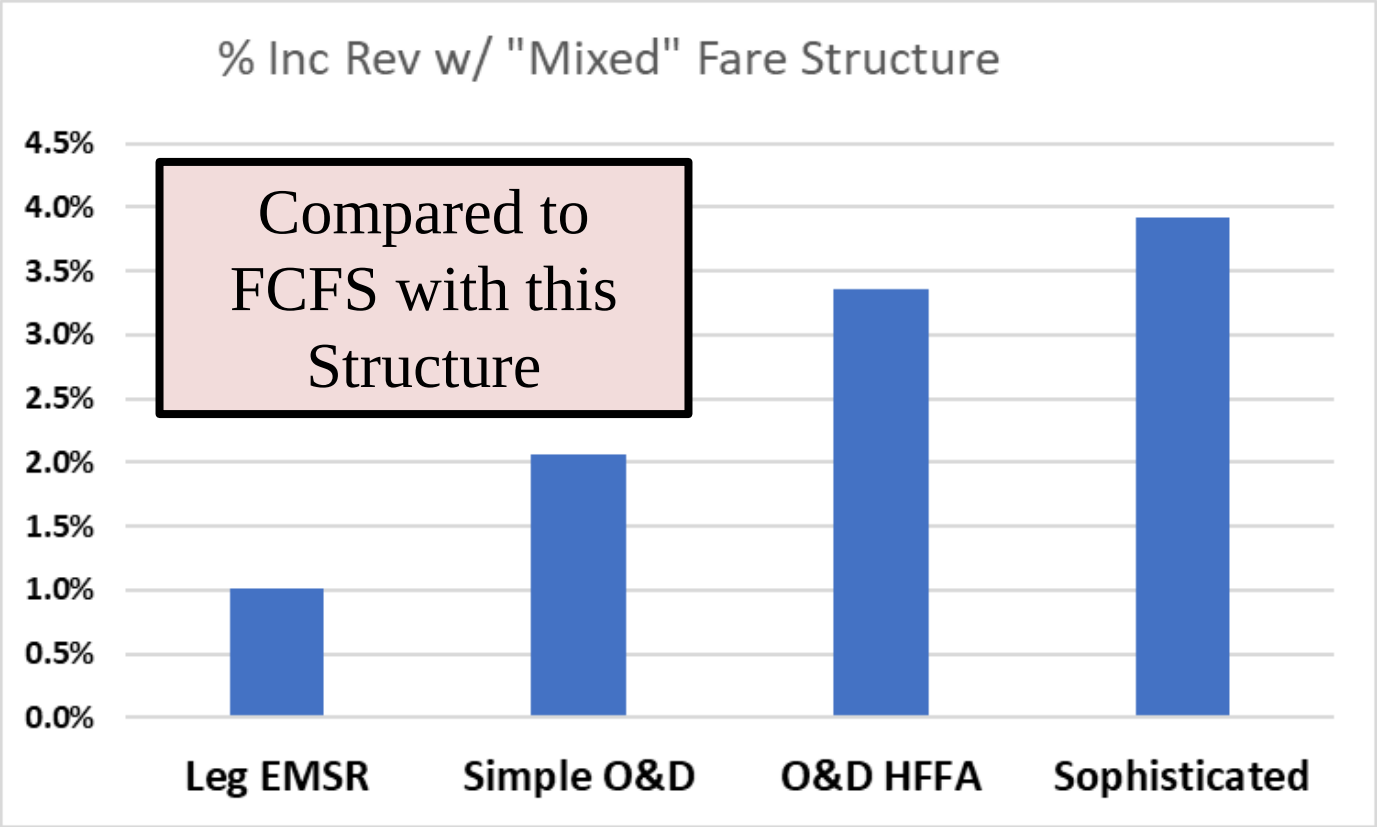
FC	AP	SAT	R1	R2
1	0	0	0	0
2	0	0	1	**0**
3	**3**	0	0	1
4	7	0	1	0
5	7	0	1	0
6	**14**	0	1	0
7	14	0	1	0
8	14	0	1	0
9	21	0	1	0
10	21	0	1	0

International

FC	AP	SAT	R1	R2	R3
1	0	0	0	0	0
2	0	0	0	0	1
3	3	0	0	1	0
4	3	1	0	0	0
5	7	0	0	1	1
6	14	1	1	0	0
7	14	0	1	1	1
8	21	1	0	1	0
9	21	1	1	0	1
10	28	1	1	1	0

Experimental Design: Vary Advance Purchase Requirements & Restrictions

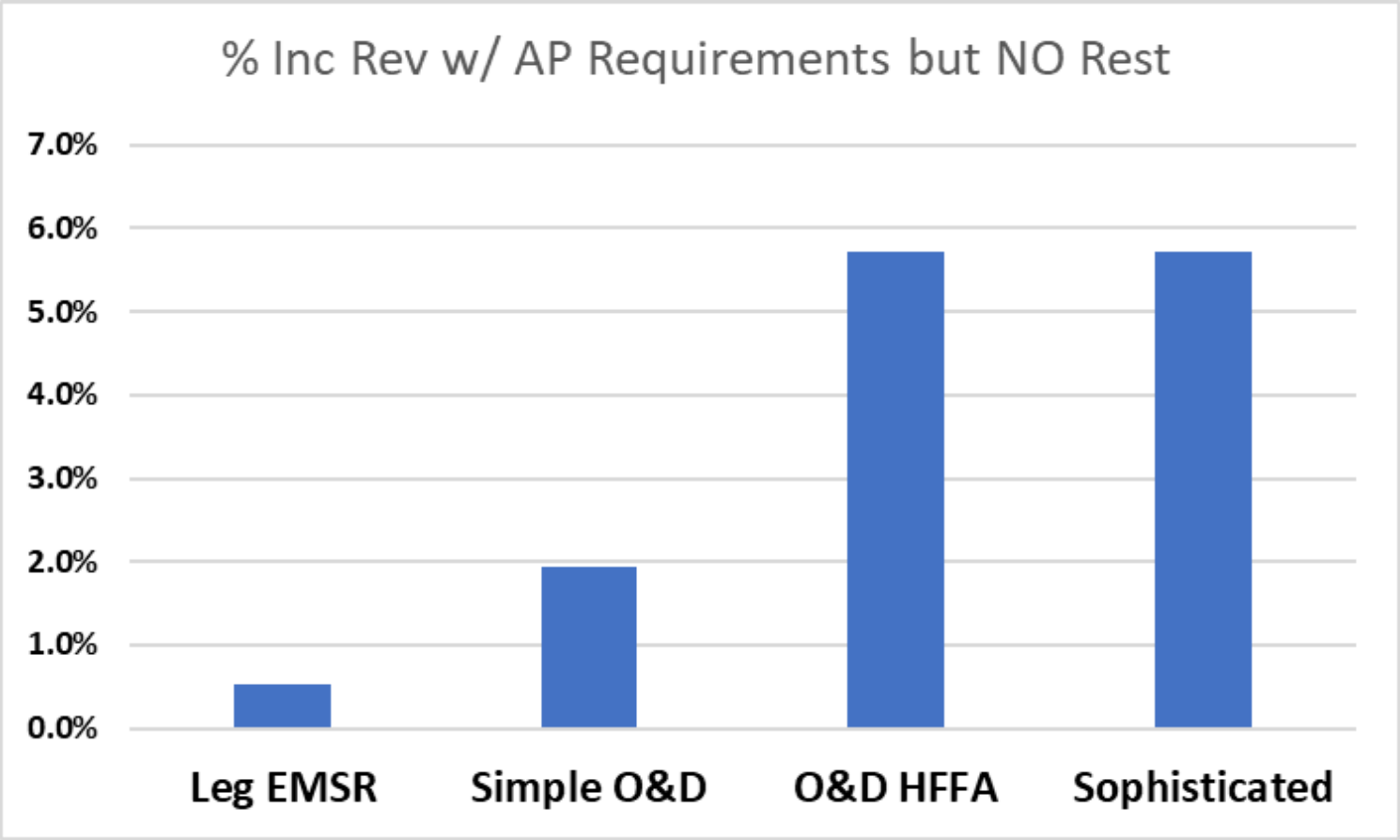
- Does "sophistication" protect if many of the markets have fewer restrictions? (e.g. 1/3 have no Sat Stay)



Leg EMSR uses leg-forecast; "Simple O&D" is DAVN; O&D also using HFFA, "Sophisticated RM" is UDP w/ Hybrid Forecasting and Fare Adjustment

How About If There are AP Requirements but no Other Restrictions?

- Results vs. FCFS with AP but no other restrictions:



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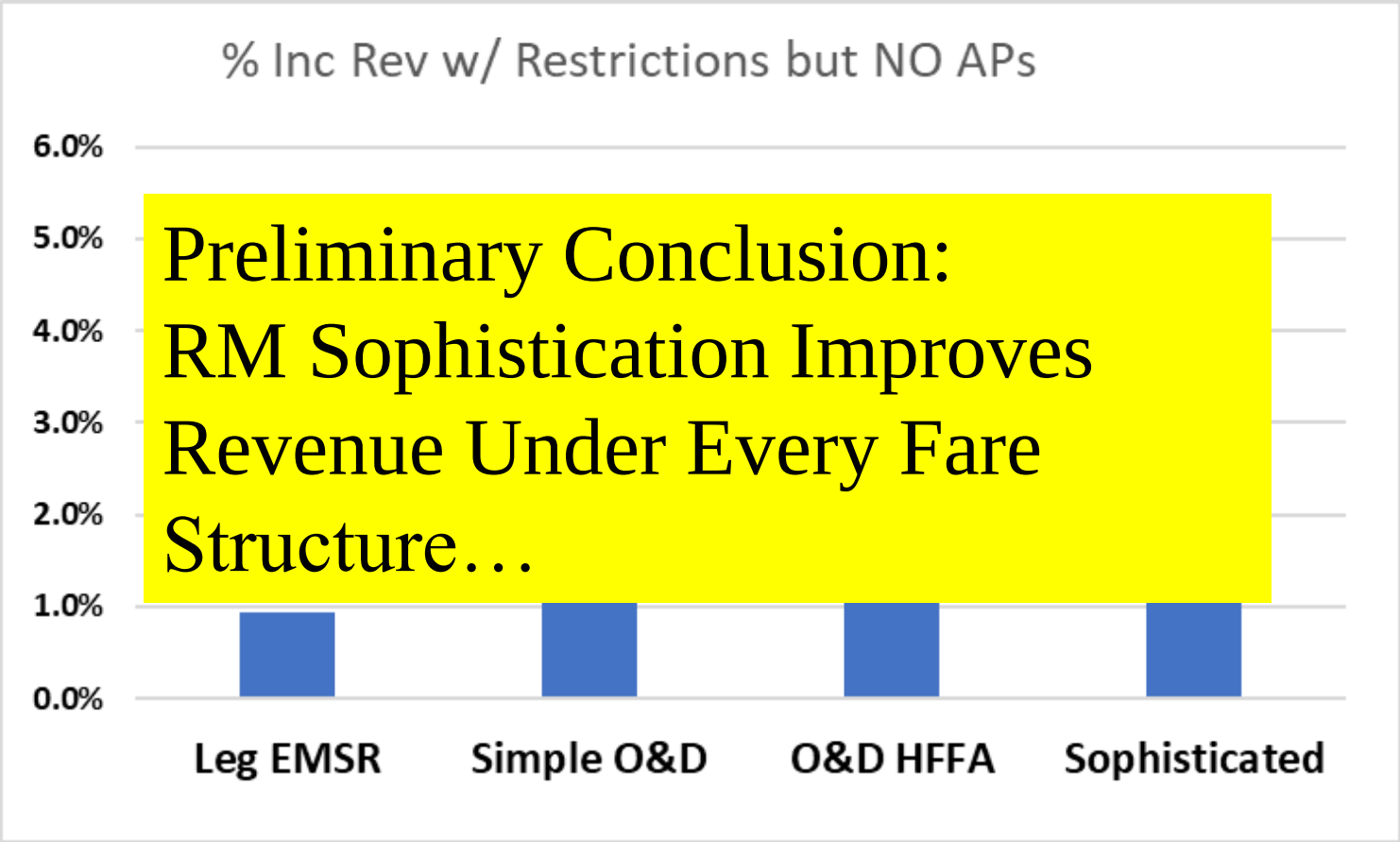
How About If There are Restrictions but NO AP Requirements?

- Results vs. FCFS with restrictions but no APs:



Preliminary Conclusion:
RM Sophistication Improves Revenue Under Every Fare Structure…

Leg EMSR uses leg-forecast; "Simple O&D" is DAVN; O&D also using HFFA, "Sophisticated RM" is UDP w/ Hybrid Forecasting and Fare Adjustment

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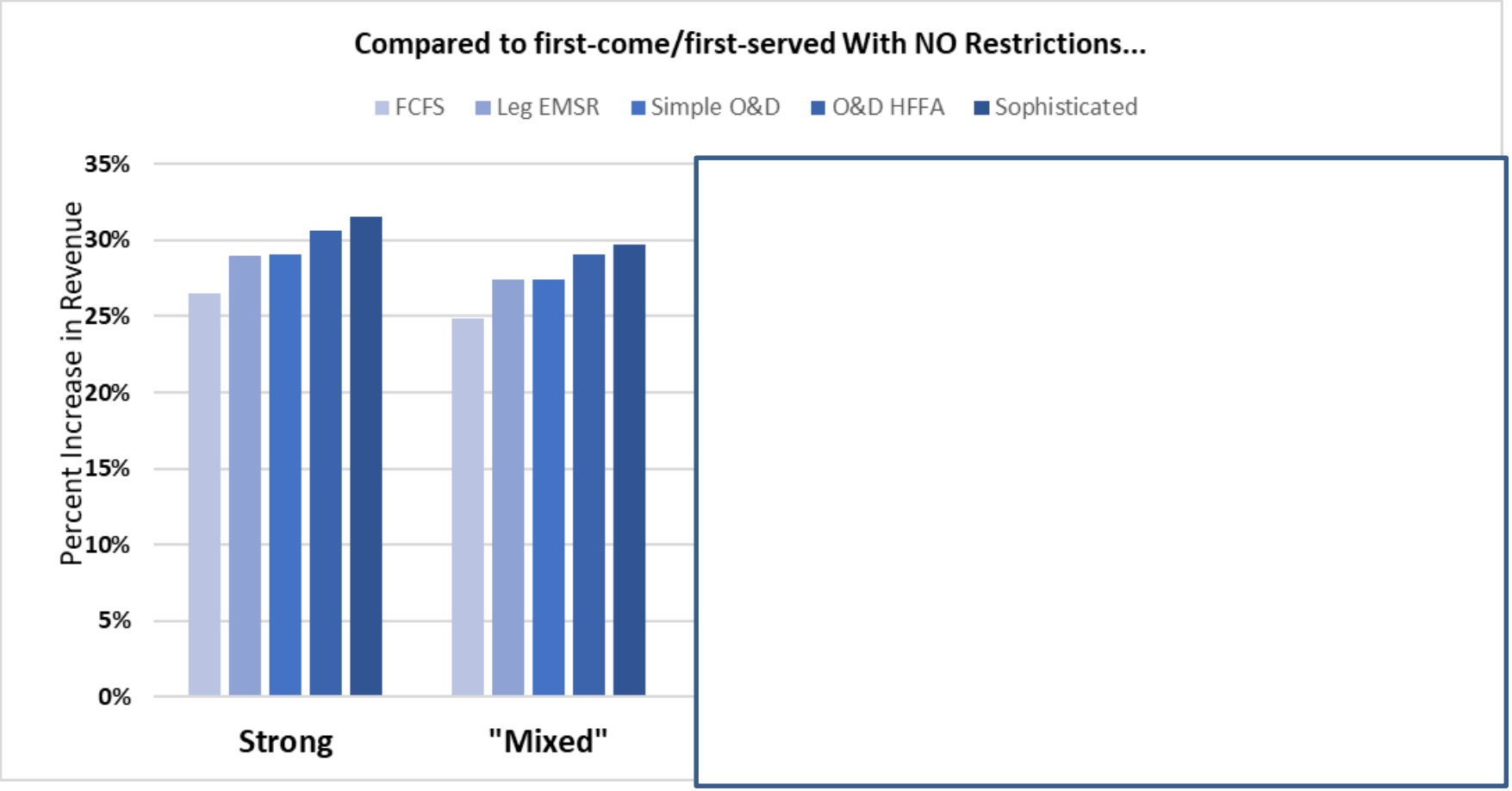
But…!

"Better" RM results in more revenue under any fare structure…



"Strong" is CAB-like; "Mixed" means some markets have weak res; "APs only" and "Res only"; "None" means no restrictions or APs

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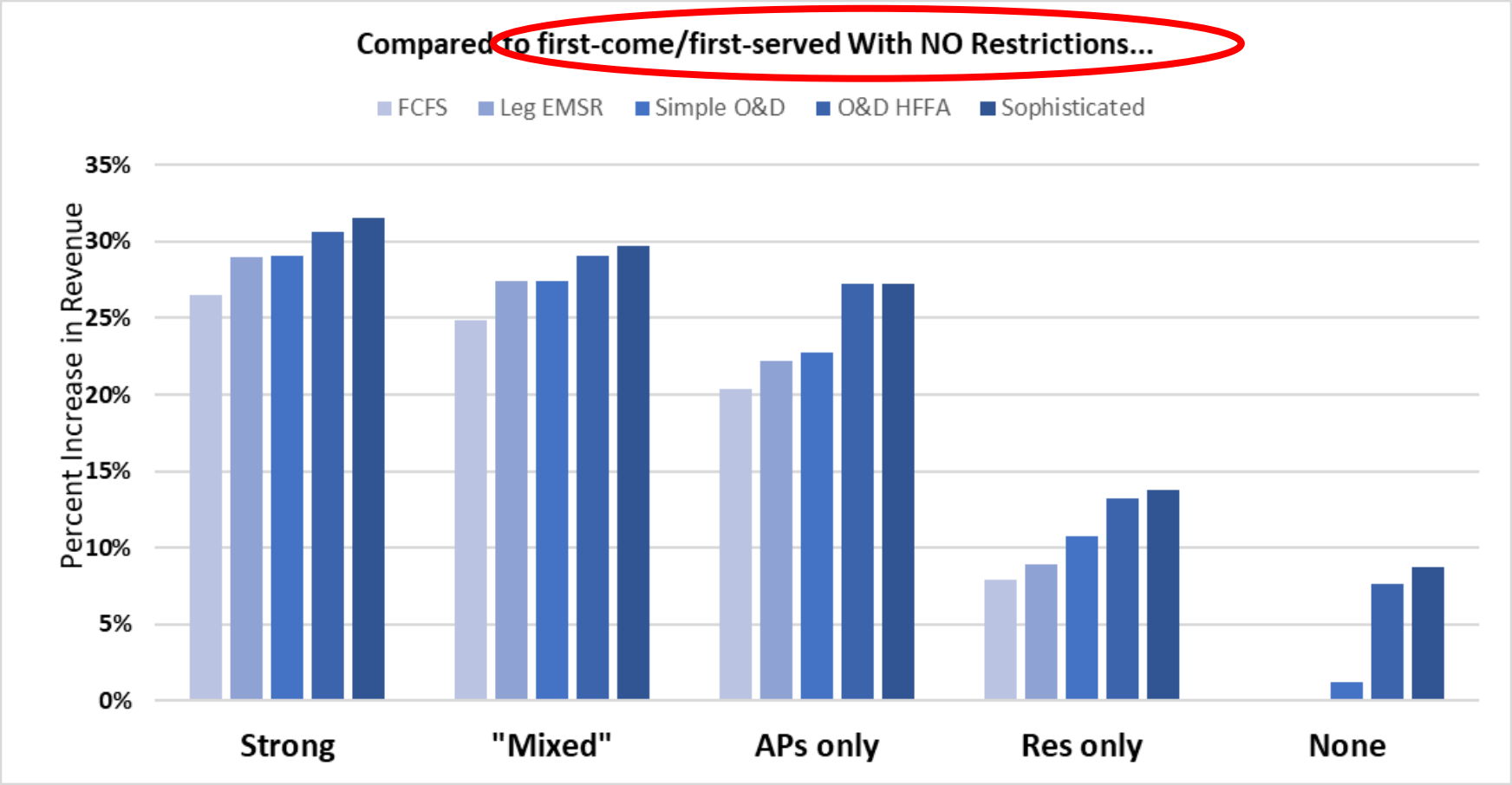
Sophisticated RM Helps! BUT…!

"Better" RM results in more revenue under any fare structure…



"Strong" is CAB-like; "Mixed" means some markets have weak res; "APs only" and "Res only"; "None" means no restrictions or APs

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Summary from the Experiments

- More sophisticated Revenue Management algorithms improve airline economics under a wide array of fare structures
- All tested RM algorithms benefit from restrictions and conditions which reinforce market segmentation
- The best experimental results come from sophisticated algorithms combined with thoughtful restrictions
  - And Fare Structure may be more powerful than RM "Sophistication"

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Implications of and for Dynamic Pricing
(from my ATPCO/DynPricing Working Group Pres)

- Under NDC/Dynamic Pricing, RM and Pricing Departments will have to change approaches and procedures dramatically; for example, at the very least, Dynamic Pricing will require a new definition of "match" and "equivalence"
- Initiatives may result in unforeseen competitive reactions – Airlines will need to anticipate and weigh the risks
  - This may be particularly risky to FARE STRUCTURE and LEVELS
- Things you might think about when planning NDC tactics and strategies or when evaluating NDC "products":
  - What are the assumptions behind the analyses (and, MOST IMPORTANTLY, are they likely to hold?)
  - What complications are NDC-related activities likely to cause?
- Opportunity is always accompanied by Risk…

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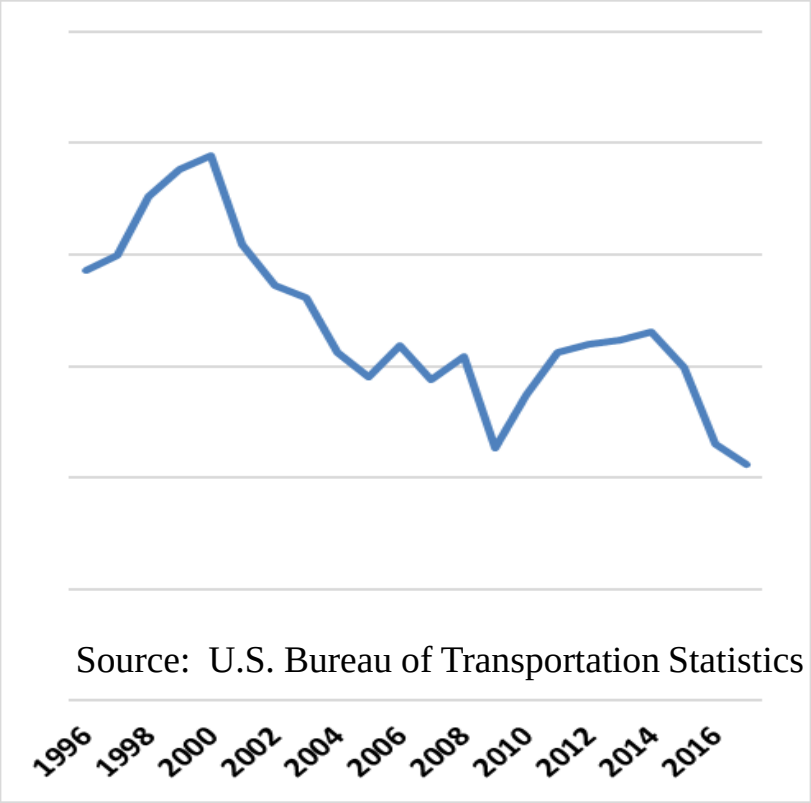
Questions? Thoughts?

The Trendline Hasn't Resolved Itself…



Source: U.S. Bureau of Transportation Statistics