MIT
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Air Transportation

NDC and Dynamic Pricing: Implications for Airline Revenue Management

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Revenue Management and Pricing International

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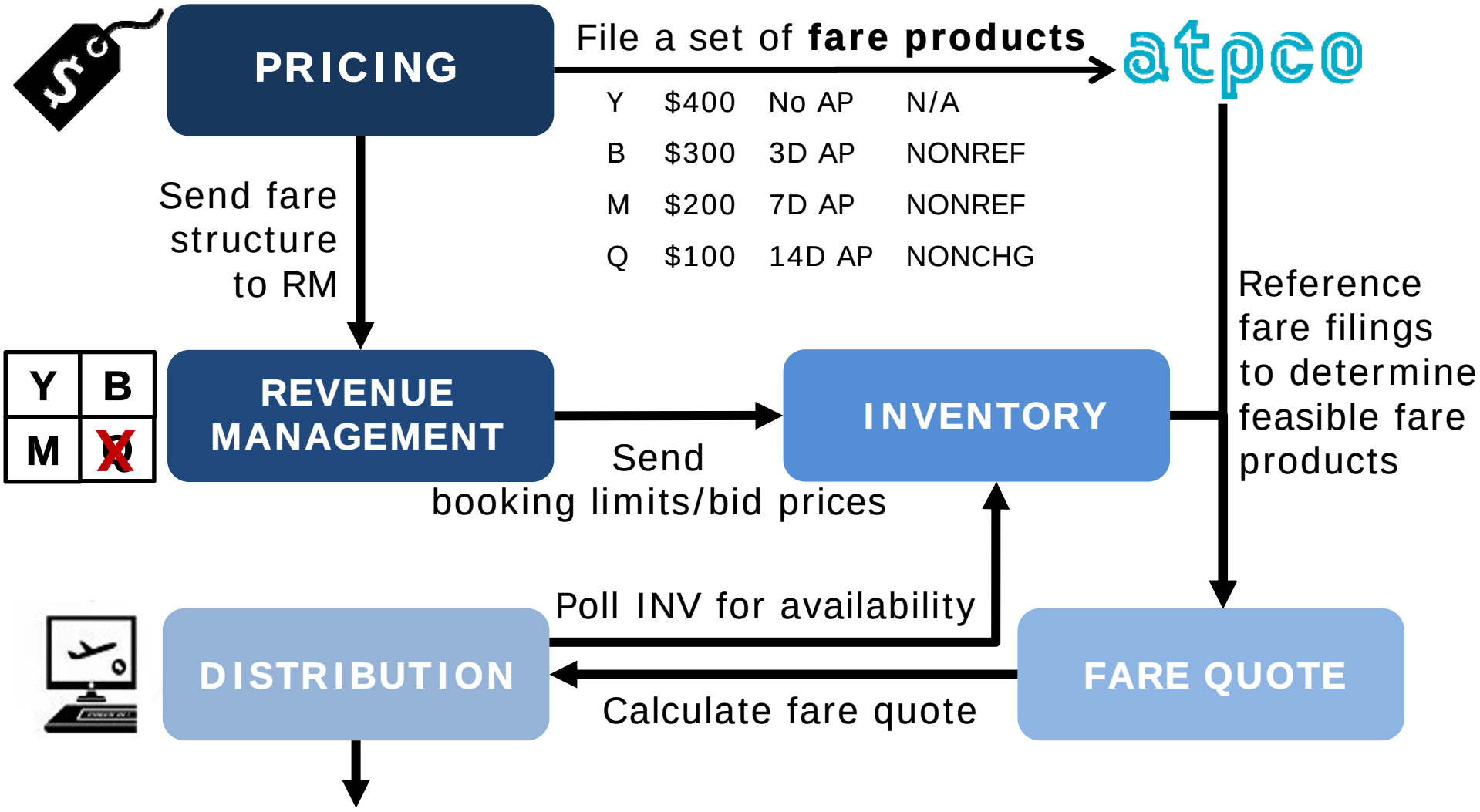
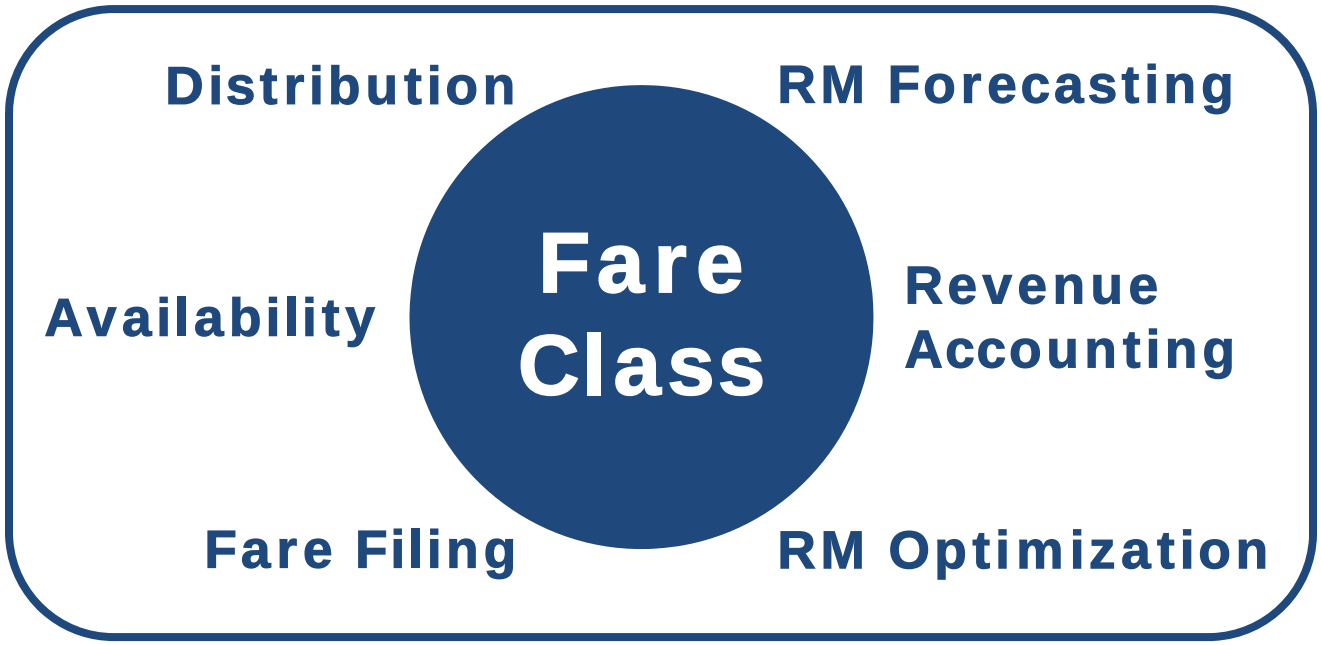
Legacy Distribution Constraints Have Led to a Complex Airfare Shopping Process



Many Legacy Processes Depend on Fare Classes

- Most airline commercial processes are centered around the **fare class**, or ***reservation booking designator (RBD).***



- The distribution requirements of indirect channels have prevented airlines from moving beyond filed fare classes.

Courtesy: M. Wittman

The New Distribution Capability Could Start to Change Some of these Legacy Processes

- IATA's New Distribution Capability (NDC) is an XML-based standard for distribution communication.
- NDC allows for more information to be exchanged in the ticket shopping process, besides availabilities and fares.
  - Including information regarding ancillary services, rich media, and **optional** personal information about the customer making the booking request, including frequent flyer numbers.
  - Prices and product offerings could be customized to each request and generated in real time.
- NDC has started a discussion about "next-generation" approaches to airline pricing and revenue management.

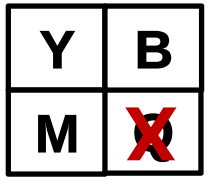
Source: IATA

What is Dynamic Pricing?

Firms practice **dynamic pricing** when they charge *different prices* to *different customers* for the *same product*, as a function of an *observable state of nature*.

- The **observable state of nature** could include:
  - **Remaining product inventory**
  - **Time remaining in the selling period**
  - **Characteristics of the customer**
  - **Characteristics of the shopping request**
  - **Forecasts of future demand**
  - **Competitor offerings**

Mechanisms for Dynamic Pricing

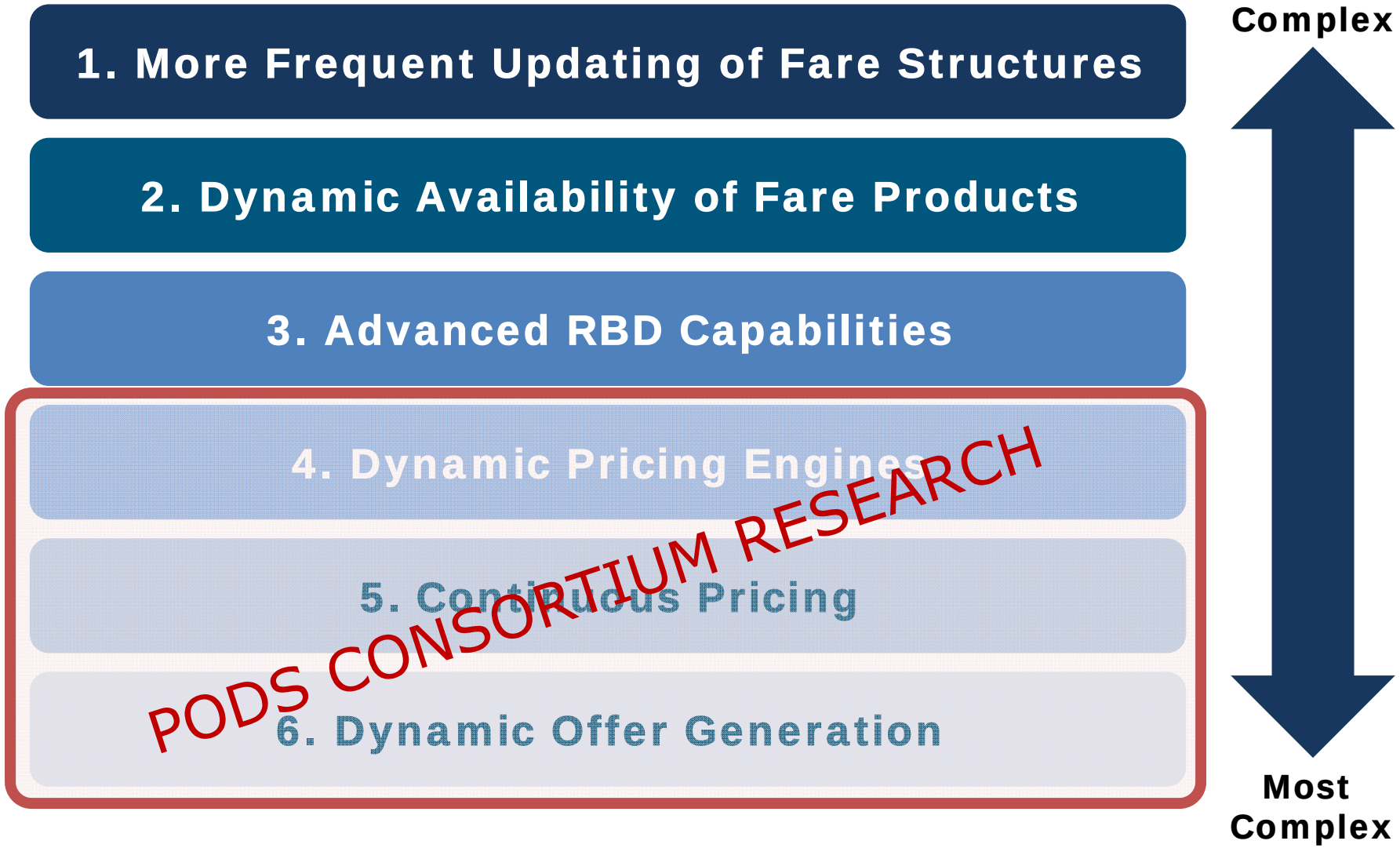
Availability-Based Pricing		▪ Select prices from a pre-defined, finite set of possible price points.
Dynamic Price Adjustment	~~$249~~ ↓ $229	▪ Start with ABP, then adjust prices up or down in certain situations.
Continuous Pricing	$499 ↕ $199	▪ Select prices freely from among a continuous range of values.

Frequency of Price Selection

Less Frequent (e.g., Daily)

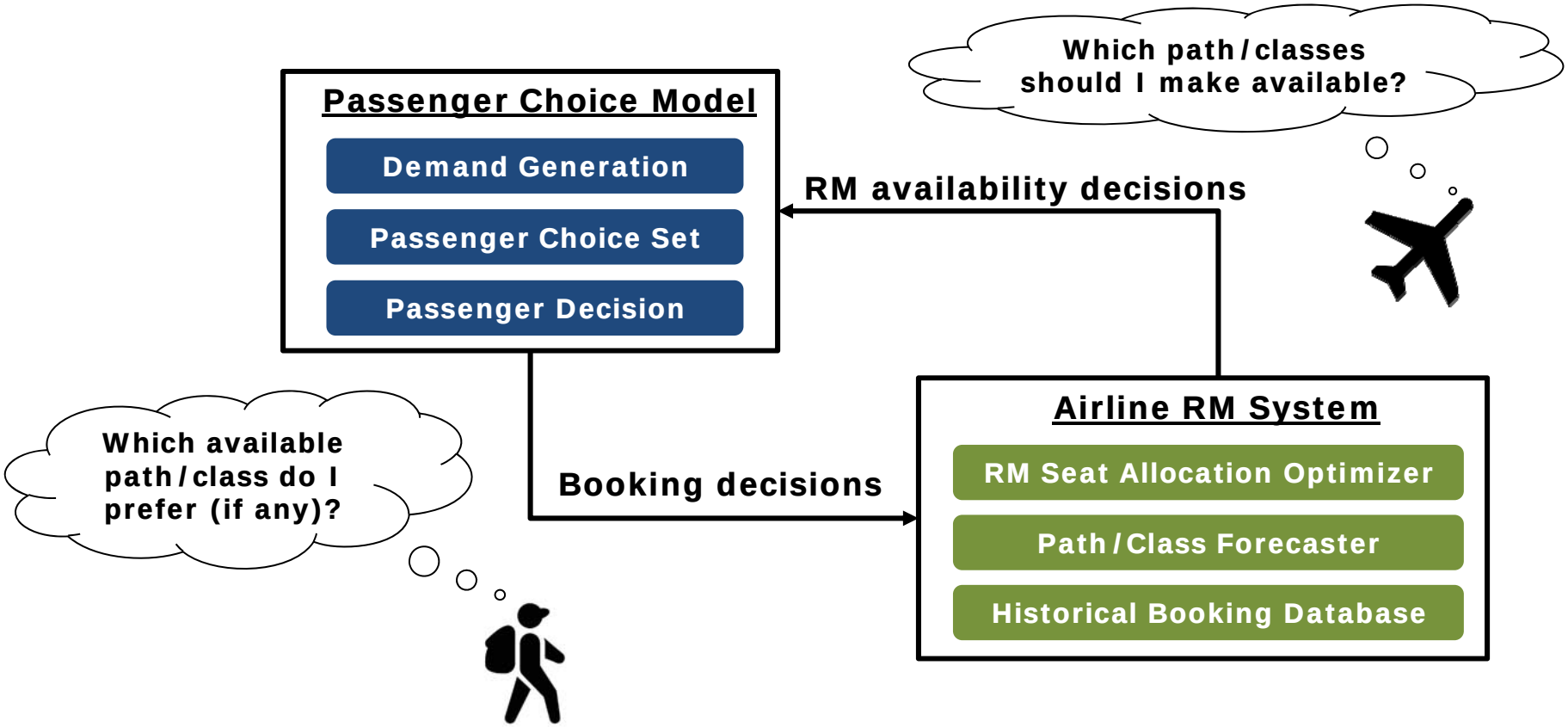
More Frequent (e.g., Transactional)

Six Next-Generation Pricing Mechanisms Are Currently Under Development in the Airline Industry



Dynamic Pricing Mechanisms Are Being Tested in the MIT PODS Revenue Management Consortium

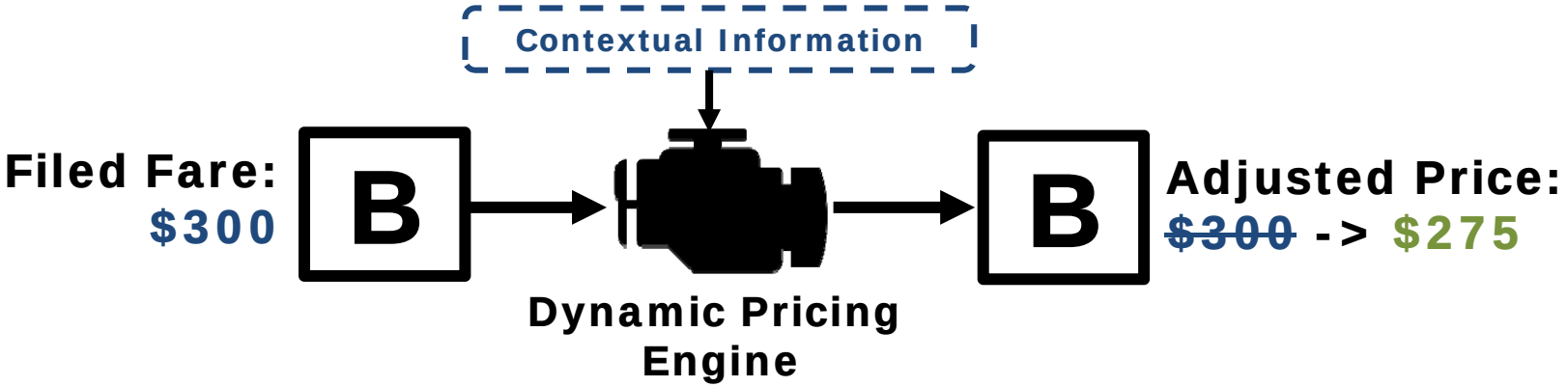
- The **Passenger Origin-Destination Simulator** (PODS) models interactions between passenger choice and airline revenue management systems:




PODS
AIR CANADA
QATAR AIRWAYS القطرية
amadeus
DELTA
Lufthansa
SWISS
Swiss International Air Lines
BRITISH AIRWAYS
الإتحاد ETIHAD AIRWAYS ABU DHABI
PROS
TURKISH AIRLINES
UNITED
ATPCO
American Airlines
BOEING
LATAM
Sabre

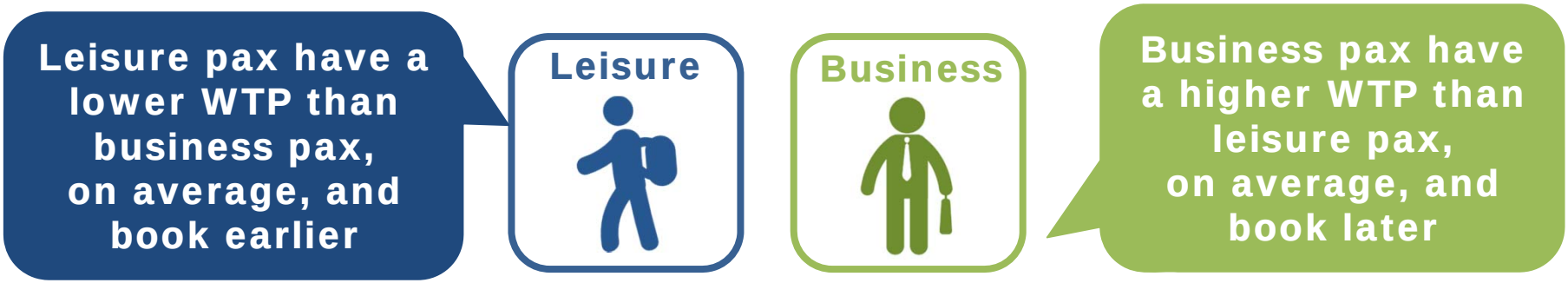
Mechanism 4: Dynamic Pricing Engines

- Dynamic Pricing Engines (DPEs) are a dynamic price adjustment mechanism that adjusts (up or down) the prices of pre-filed fare products in certain situations.
  - The DPE concept emerged from the ATPCO Dynamic Pricing Working Group.
- DPEs use contextual information to apply increments or discounts to the fares that would normally be offered by an airline RM system.



Methods for Dynamic Price Adjustments

- Consider a world with two passenger segments:



- Suppose that airlines can identify (with a certain degree of accuracy) the segment of each shopping session:

- ***Discount*** the price of the lowest-available fare product for some lower-WTP requests.

- ***Increment*** the price of the lowest-available fare product for some higher-WTP requests.

Courtesy: M. Wittman

Prerequisites for Dynamic Pricing Engines: Segmentation and Conditional WTP Estimation

- Airlines would need to segment booking requests and estimate conditional customer WTP:

Session Segmentation

- Categorize shopping sessions into segments, using:

Information about the Request

and/or

Information about the Customer

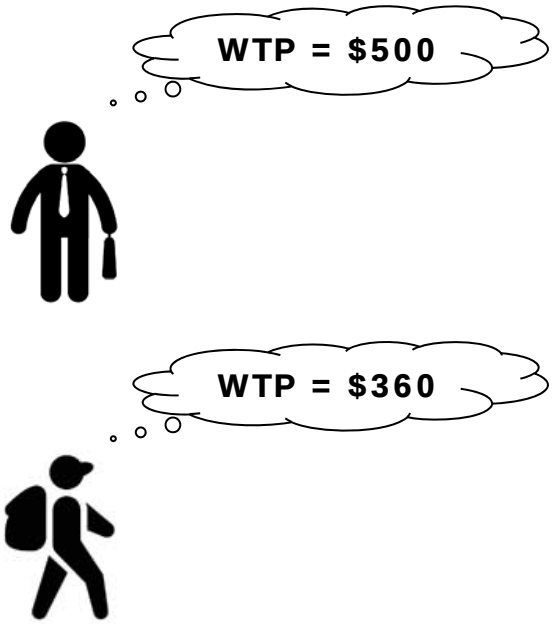
WTP Estimation

- Estimate conditional WTP for each segment and market.
- Airlines practicing advanced forecasting techniques are already estimating WTP.
  - e.g. Sell-up rates/fare adjustment
- Airlines could also use simple WTP parameters as estimates for each market and segment.

How Could Dynamic Price Adjustments Increase Airline Revenues?

Revenue-Increasing Mechanisms:

- **Offering new products to fit the needs of higher-WTP customers**
- **Stimulating new bookings from passengers with lower WTP**

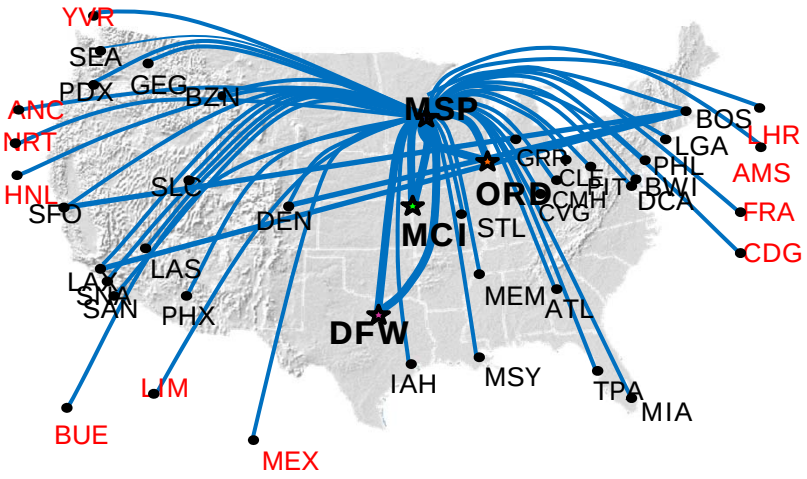


Class	Fare	
Y	$800	
B	$600	
M	$450	+ Lounge / Early Boarding
~~Q~~	$350	
~~K~~	$325	
~~X~~	$275	

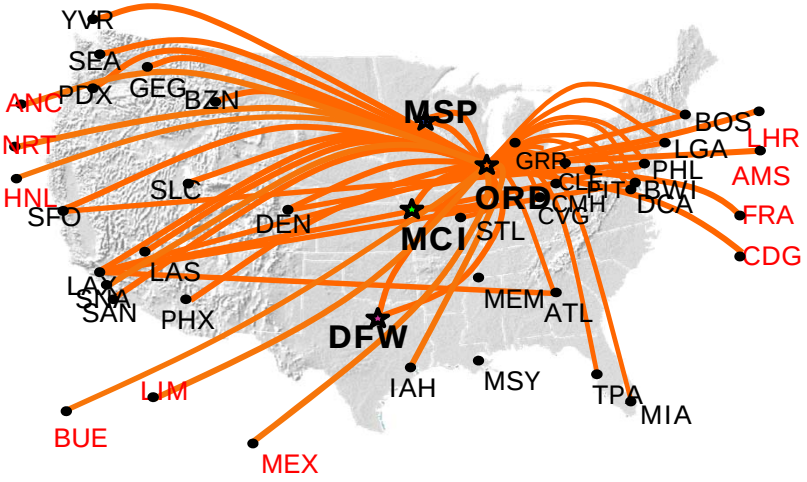
Outcome: Gain new booking at $350

Courtesy: M. Wittman

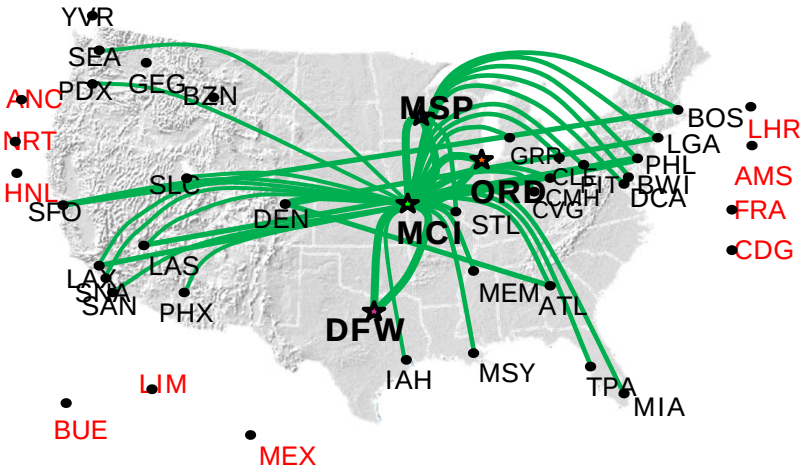
PODS Simulation Network U10 – 4 Airlines



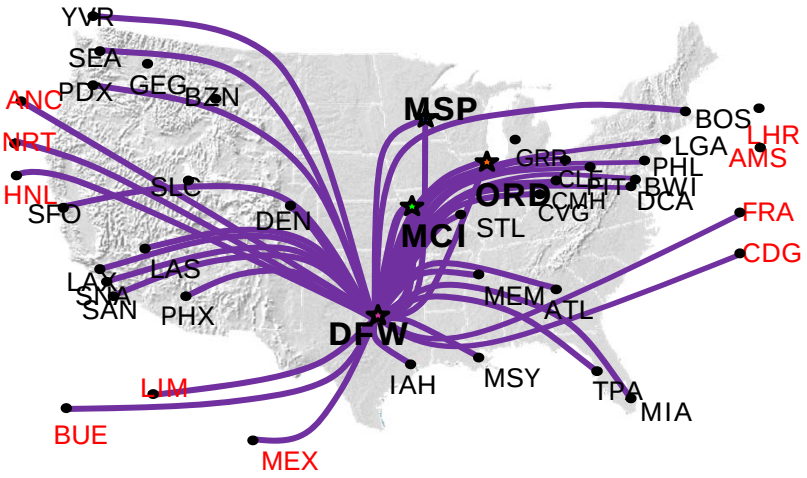
AL1 MSP Network (DAVN)



AL2 ORD Network (DAVN)

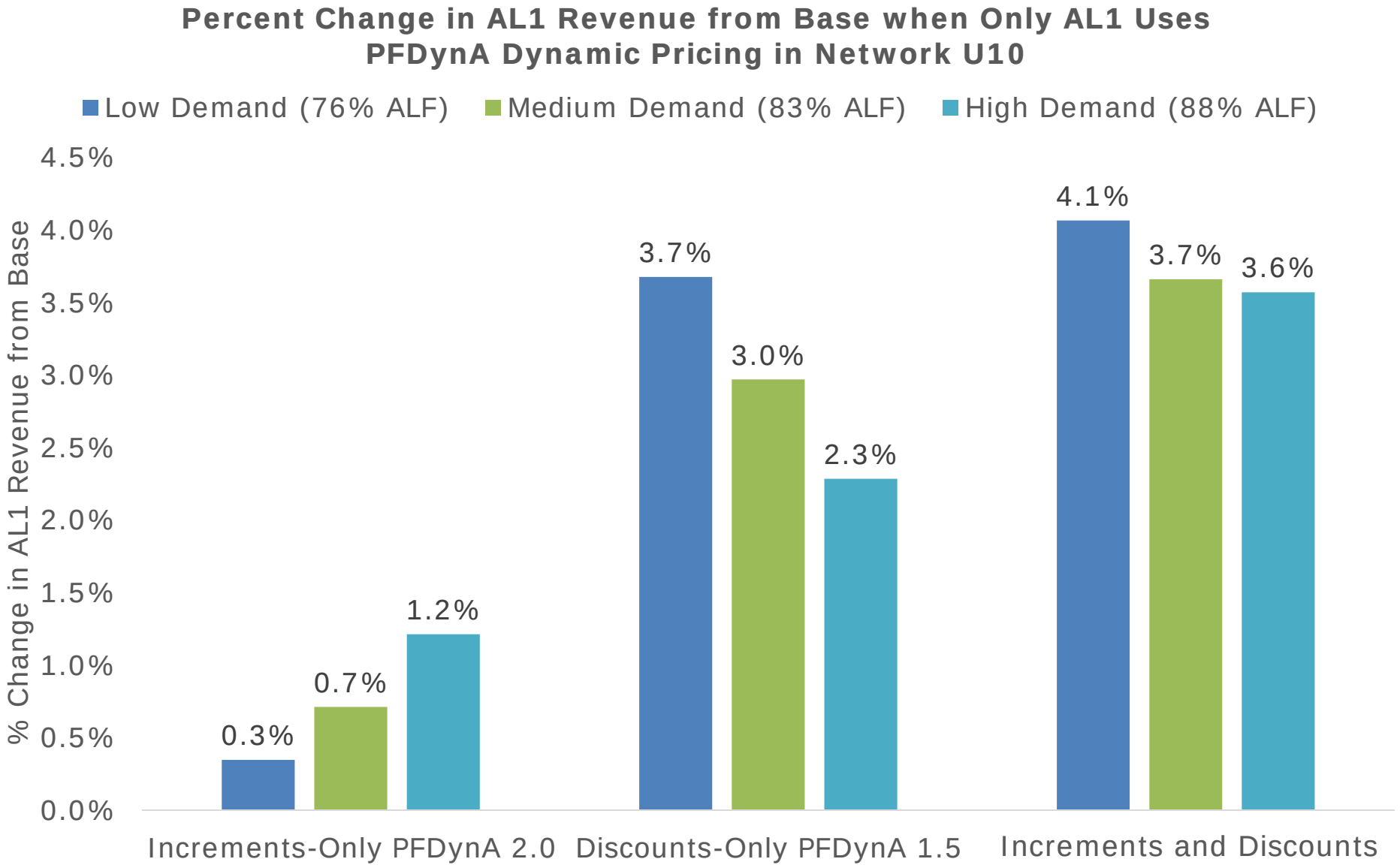


AL3 MCI Domestic Network (EMSRb)

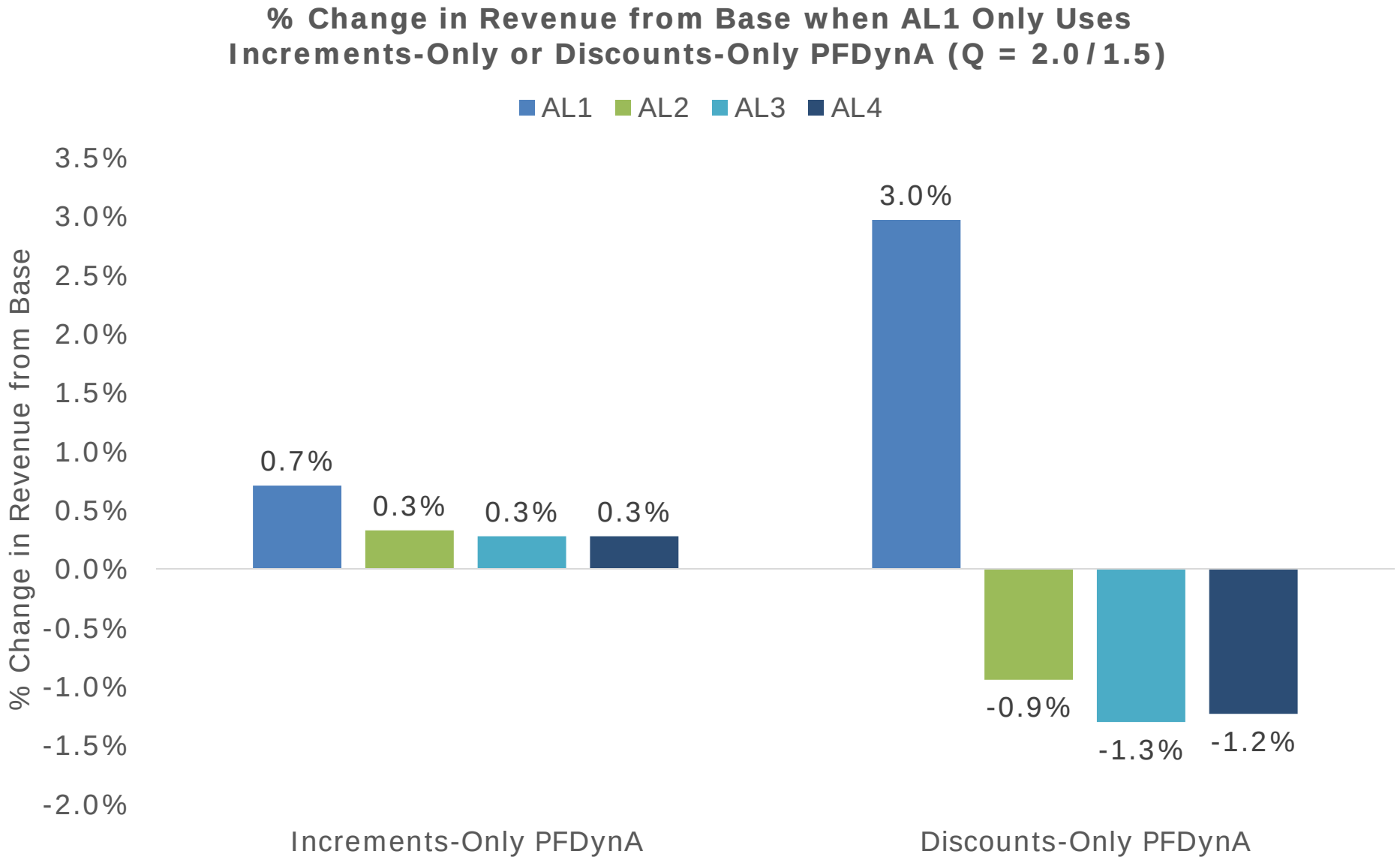


AL4 DFW Network (DAVN)

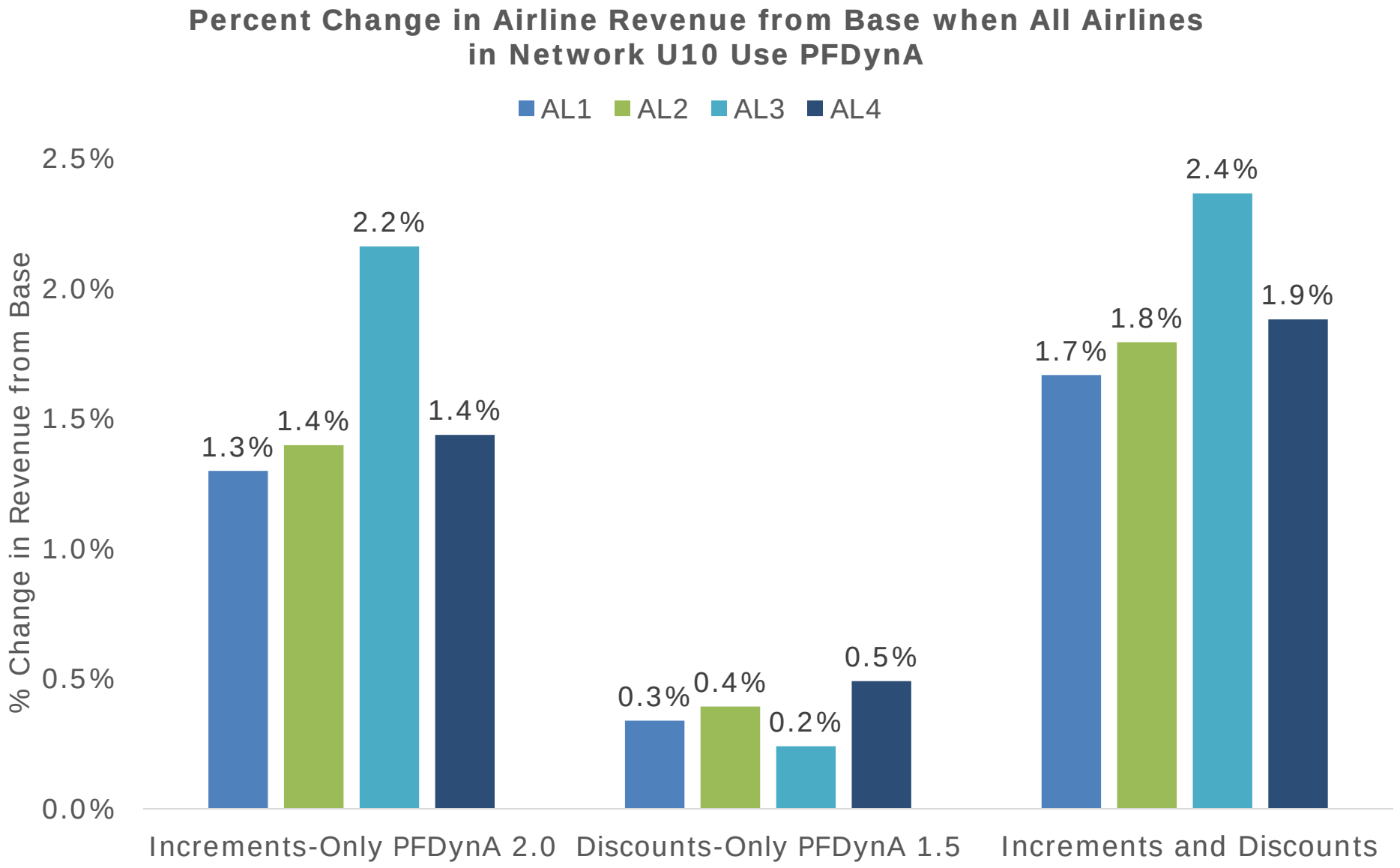
PFDynA Can Lead to Revenue Gains of Up to 4% When Used by a Single Airline in this Network



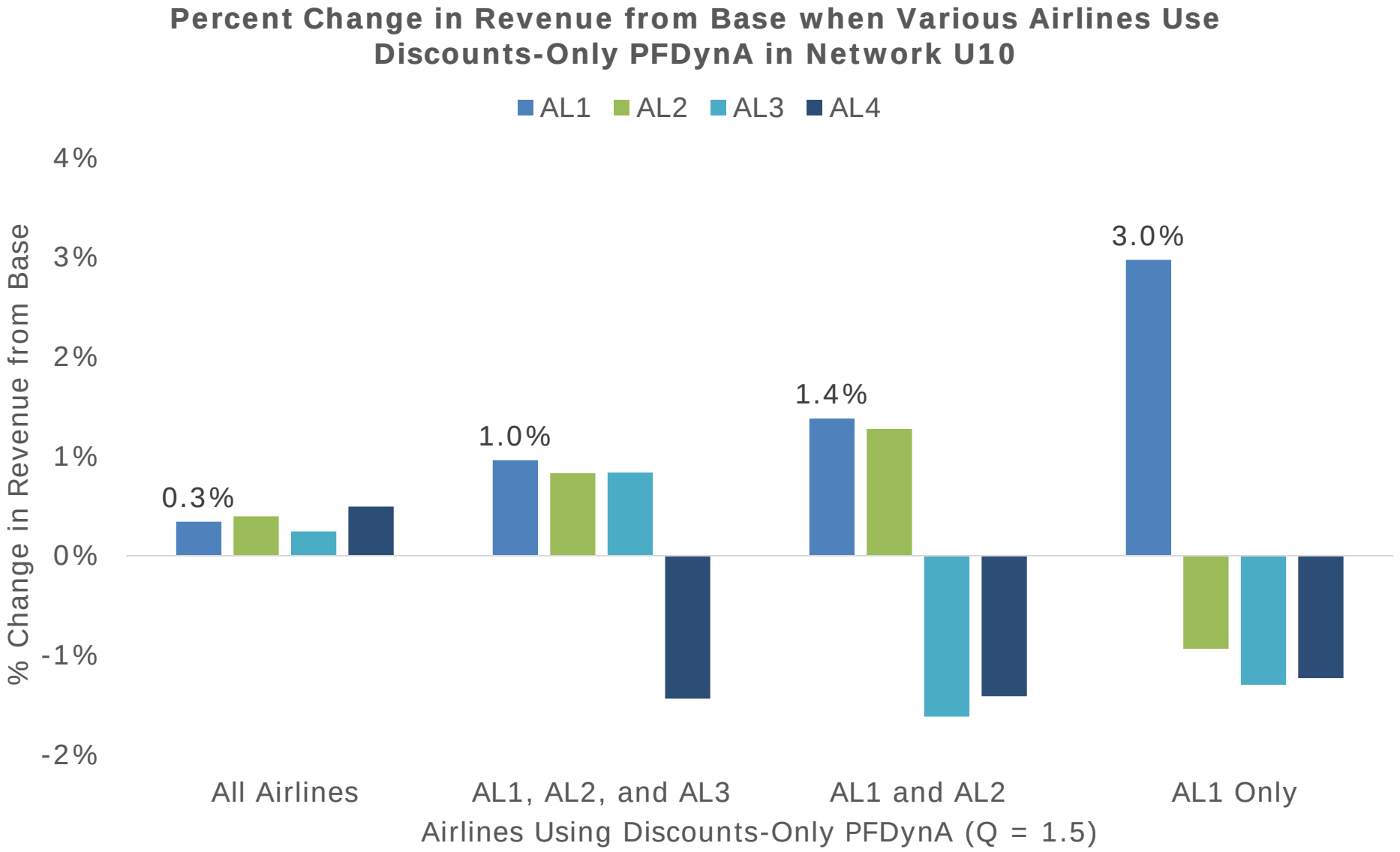
One Airline's Use of Dynamic Pricing Affects the Revenues of Other Airlines in the Network



All Airlines in the Simulation See Revenue Gains if They All Use Dynamic Price Adjustment



There Appears to Be a First-Mover Advantage with Discounts-Only Dynamic Pricing



Mechanism 5: Continuous Pricing

- Unlike Dynamic Pricing Engines, continuous pricing does not rely on a set of pre-determined price points:
  - Airline generates a single “optimal” price to quote at a given time
- Two possible options for distribution:
  - **File a separate fare basis** for each possible price point, then use continuous pricing to select which price to display.
  - **Use the New Distribution Capability** to distribute continuously chosen prices without reference to pre-determined price points.
- Either approach requires new WTP-based RM forecasting and optimization processes.
  - But, could be based on existing class-based RM or new classless RM databases and algorithms

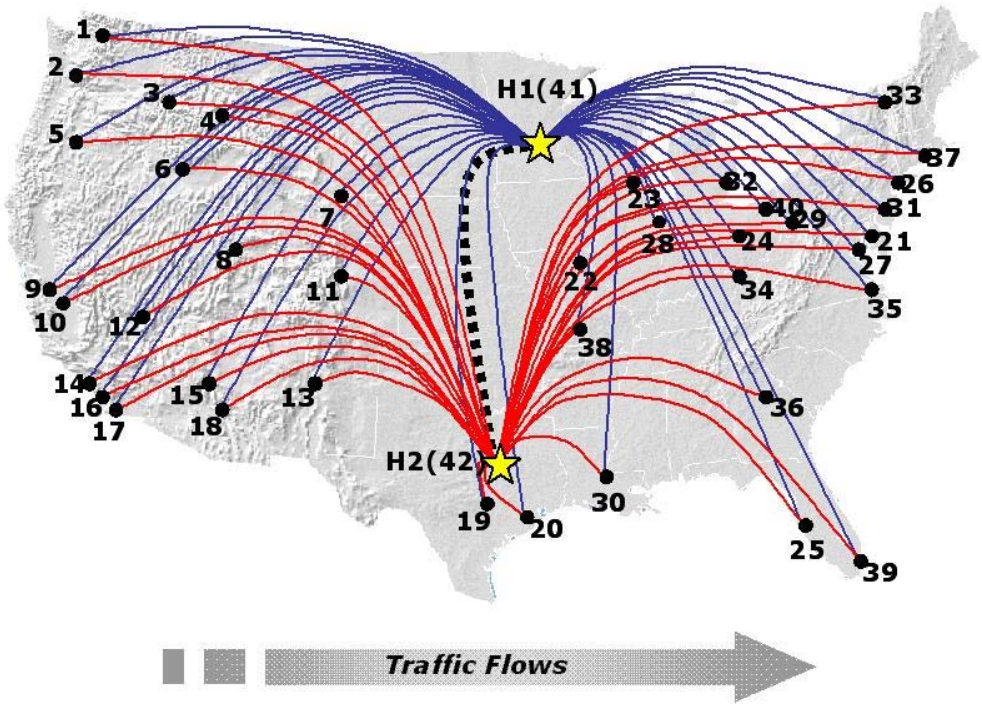
Classless RM and Continuous Pricing Framework

		Forecasting and Optimization	
		Class-Based	**Classless**
Pricing / Distribution	**Fixed Price Points**	**Traditional Class-Based RM**	**Classless for Fixed Prices RM**
	Continuous	**Class-Based RM for Continuous Pricing**	**Classless RM for Continuous Pricing**

Unrestricted Network D6

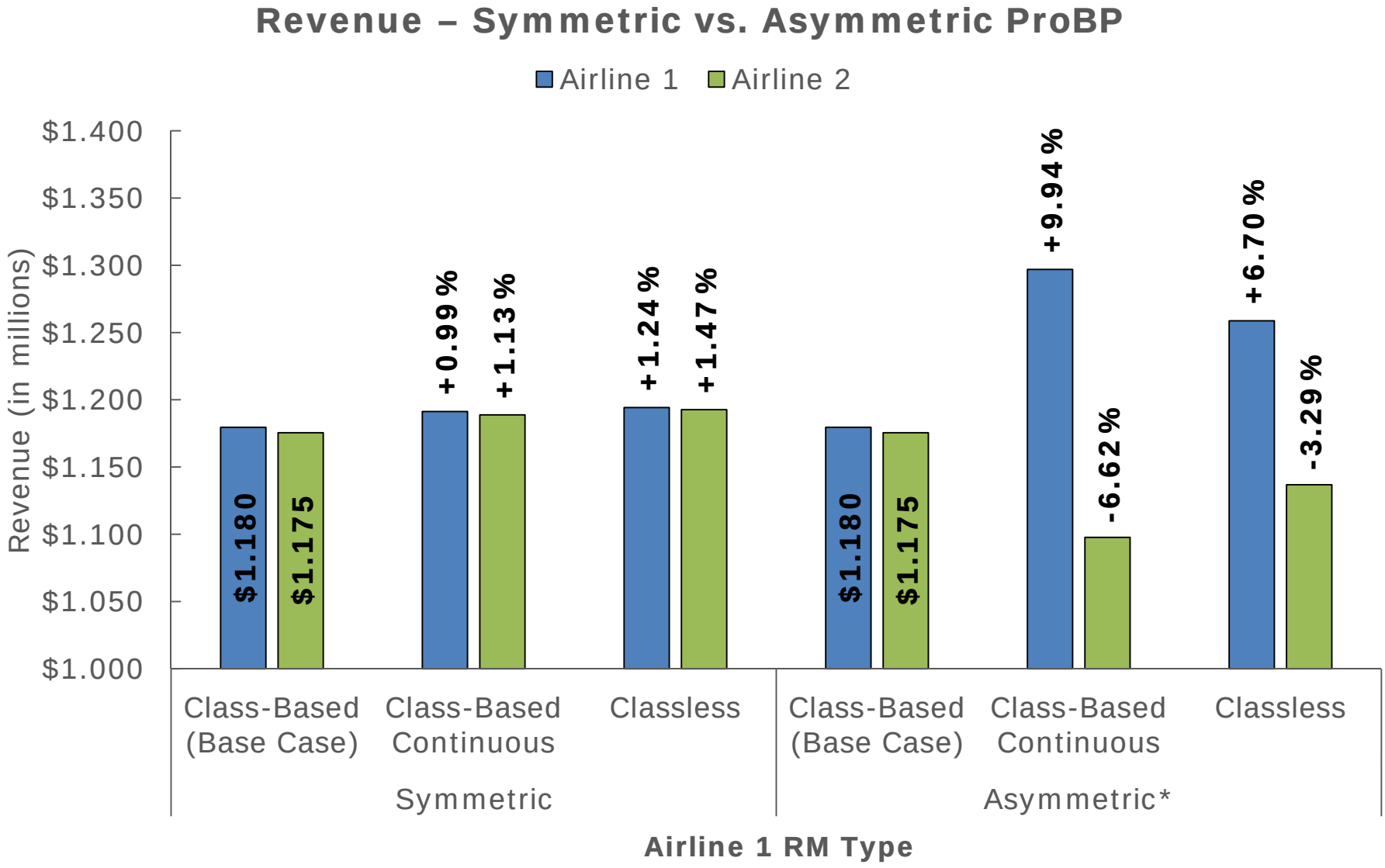
- 2 airlines
- 40 Spoke Cities
- 252 legs
- 482 OD markets
- 6 fare classes

Class	AP	R1	R2	R3
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0



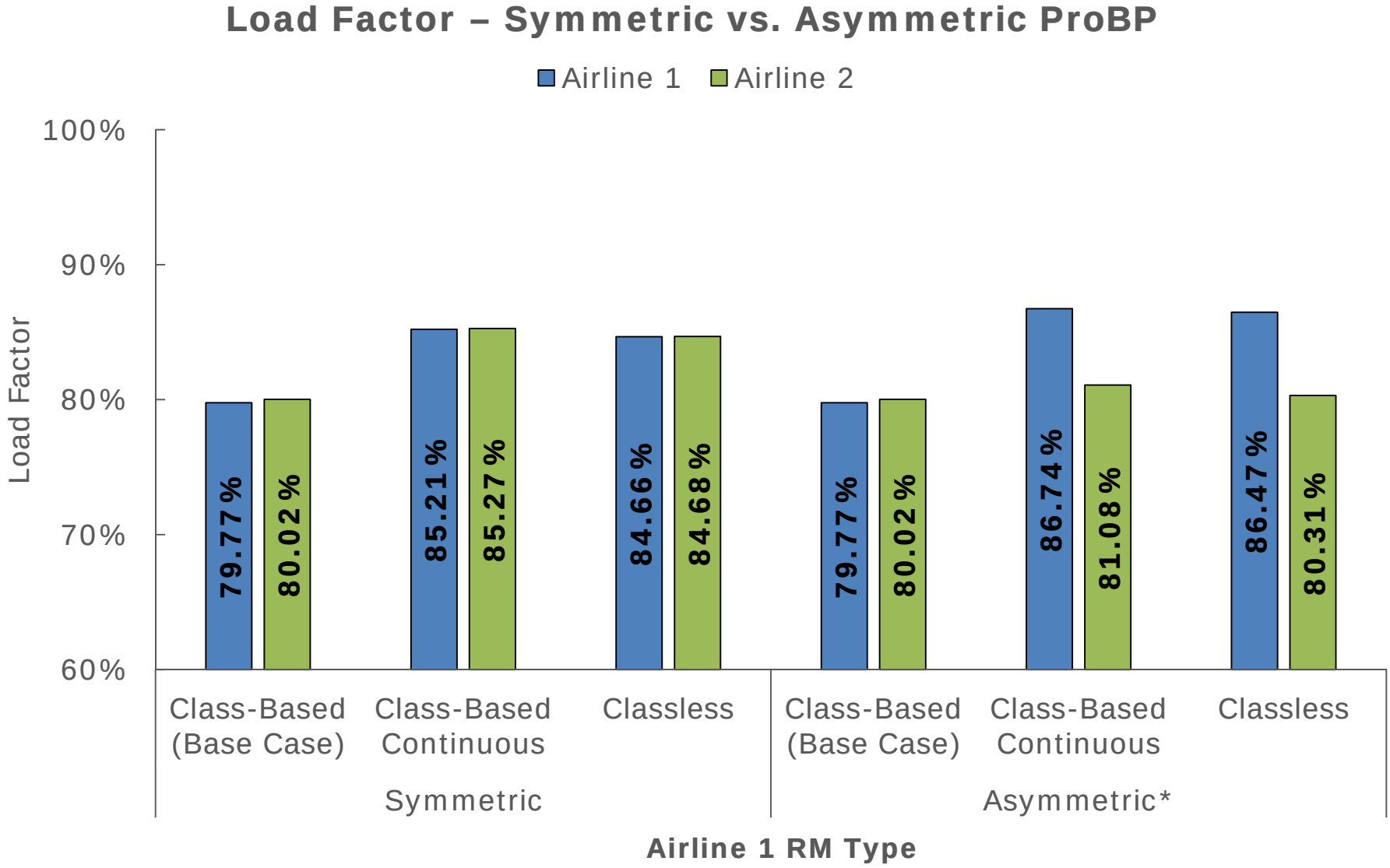
Class	1	2	3	4	5	6
Average Fare	$412.85	$293.34	$179.01	$153.03	$127.05	$101.06
Minimum Fare	$188.33	$136.83	$87.58	$76.39	$65.19	$54.00
Maximum Fare	$742.52	$514.82	$297.02	$247.52	$198.02	$153.00

Small Revenue Gains When Both Airlines Implement, Large Gains When One Airline Uses Continuous Pricing



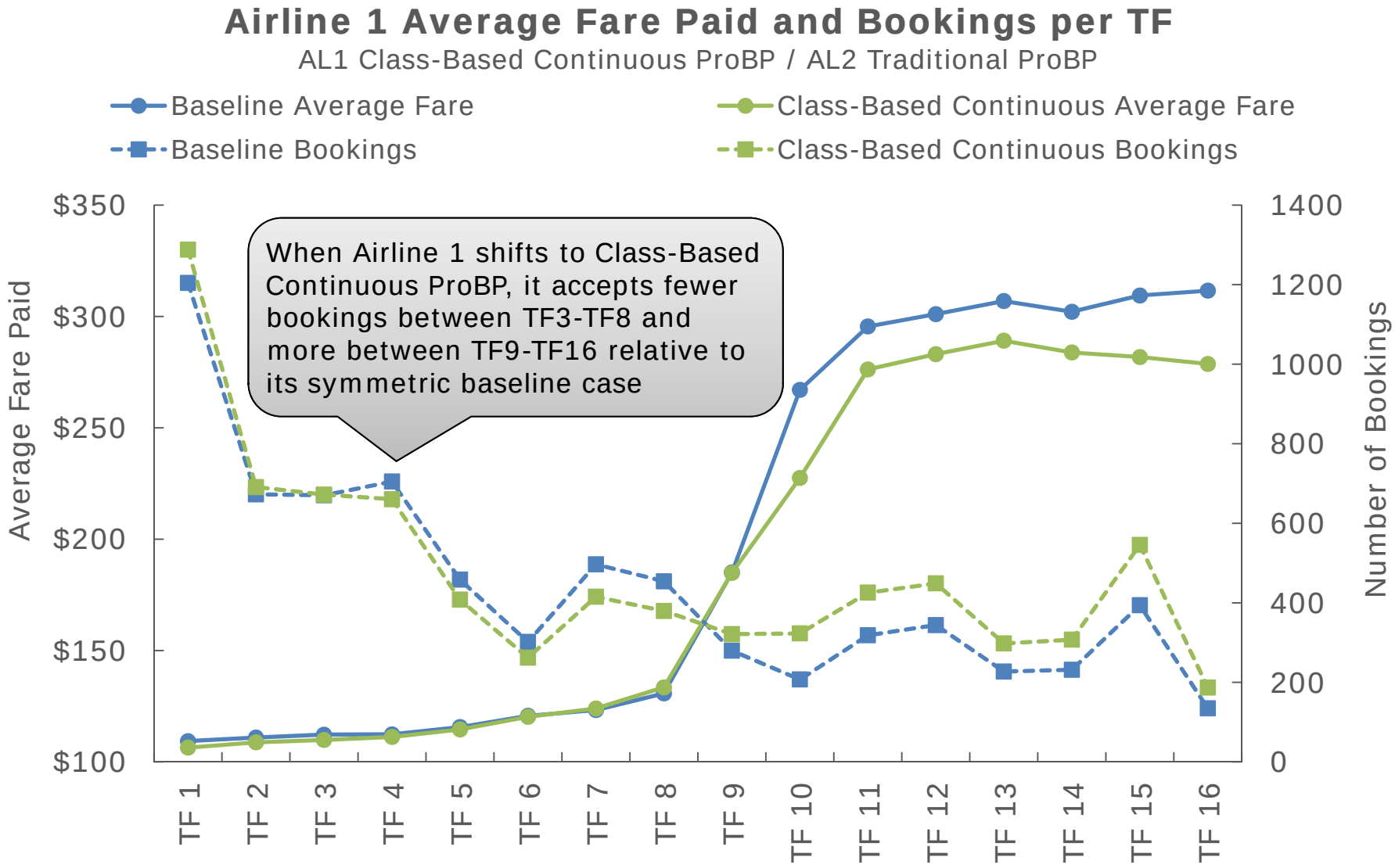
* In the asymmetric cases, Airline 2 always uses Traditional Class-Based RM

Airline 1 Implementing Either Form of Continuous Pricing Sees Large Increase in Load Factor



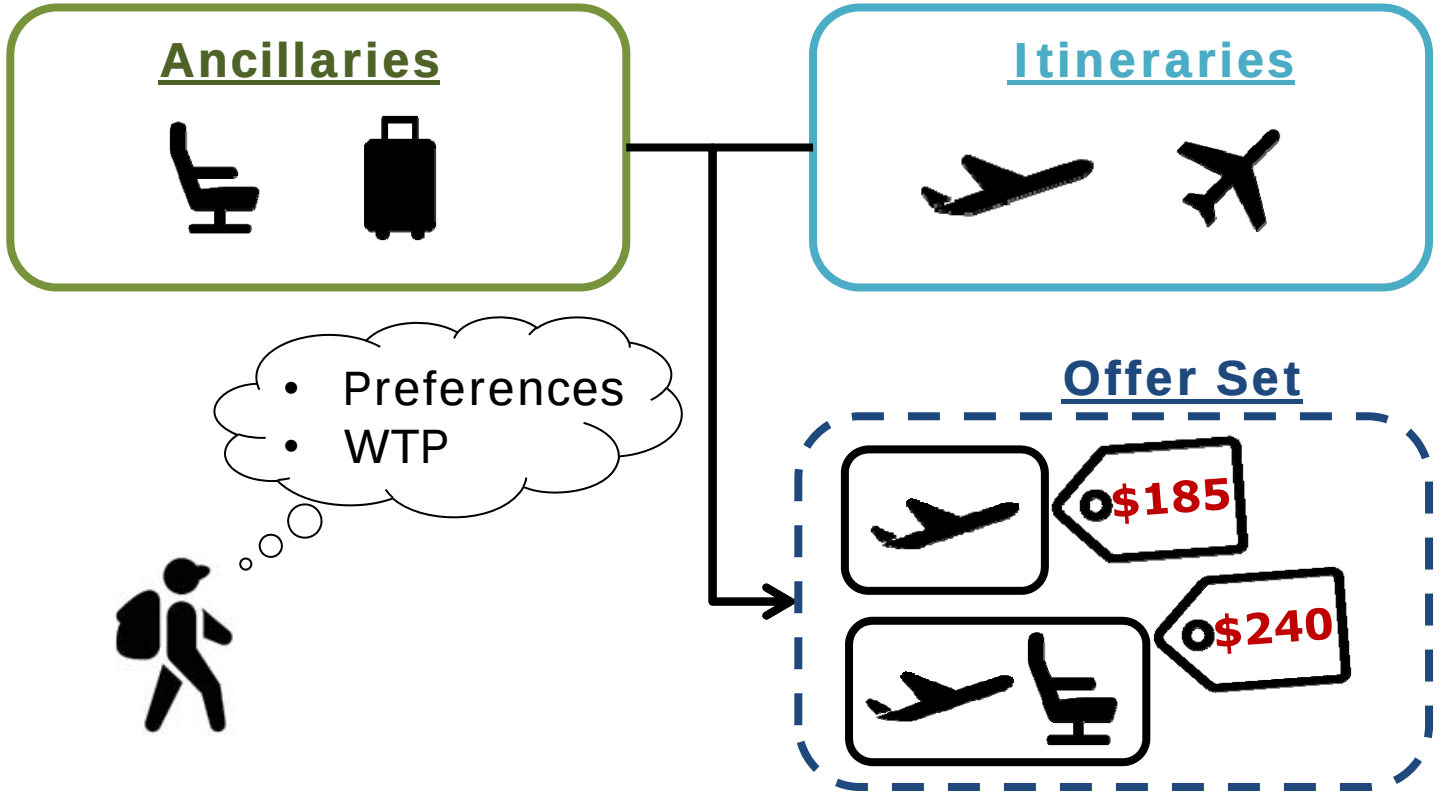
* In the asymmetric cases, Airline 2 always uses Traditional Class-Based RM

Airline 1 With Class-Based Continuous Pricing Records More Bookings at Lower Average Fares Closer to Departure



Mechanism 6: Dynamic Offer Generation

- Dynamic offer generation combines the product creation and price selection processes into a single mechanism:

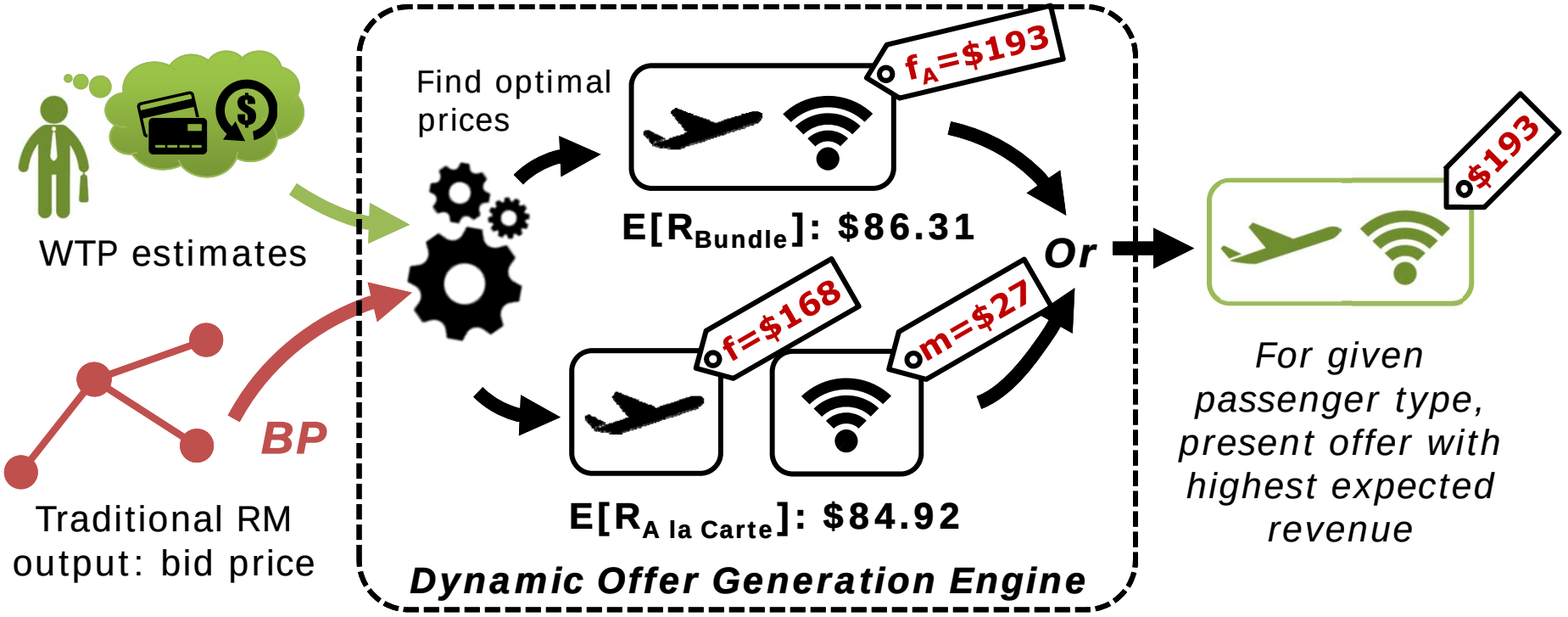


Select and price a set of offer(s) that maximizes expected revenue from each booking request

Method for Dynamic Offer Generation (DOG)

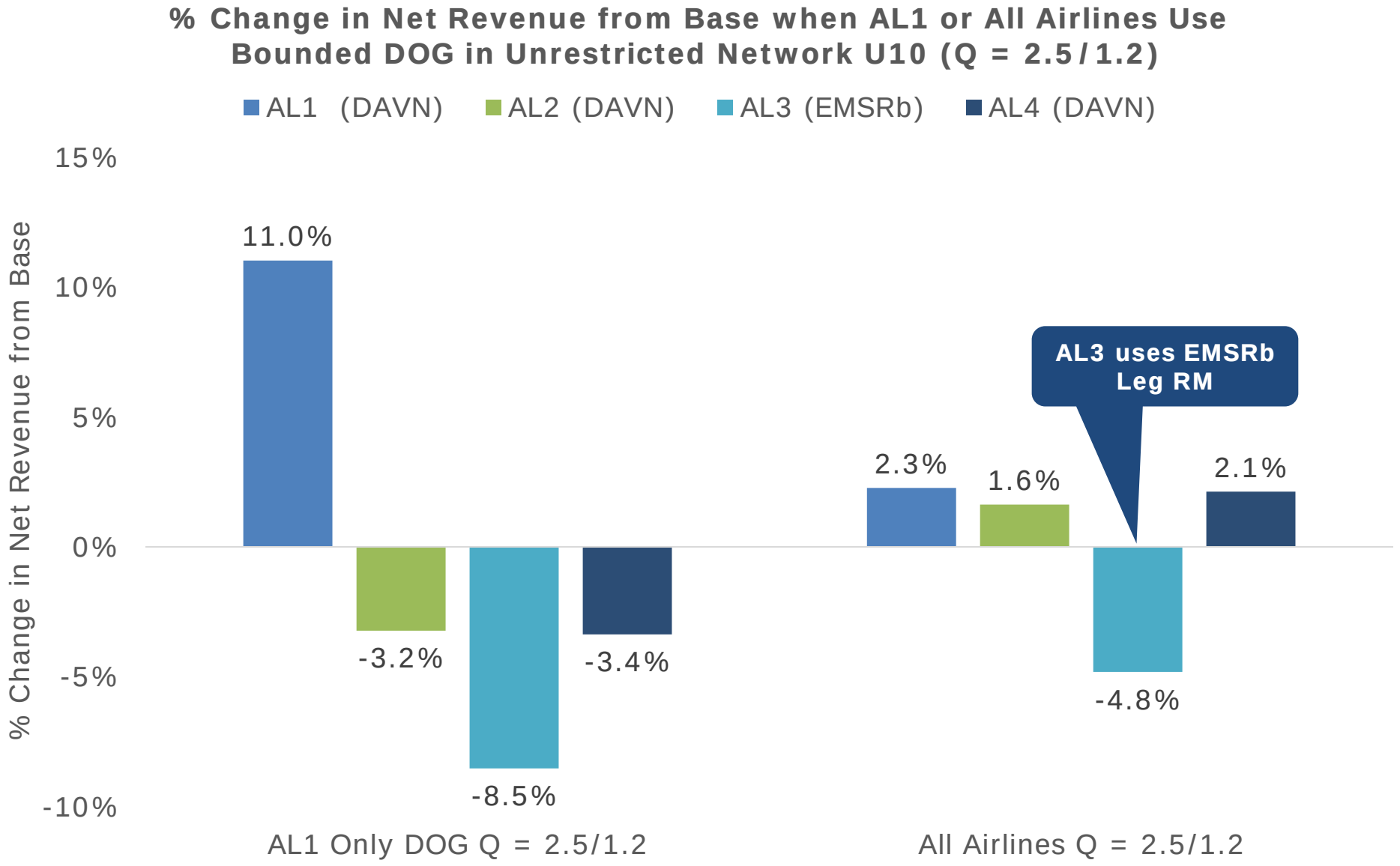
- Continue to assume the airline can differentiate two passenger segments

- Dynamically assemble and price an offer that maximizes expected revenue for the airline for each passenger type:

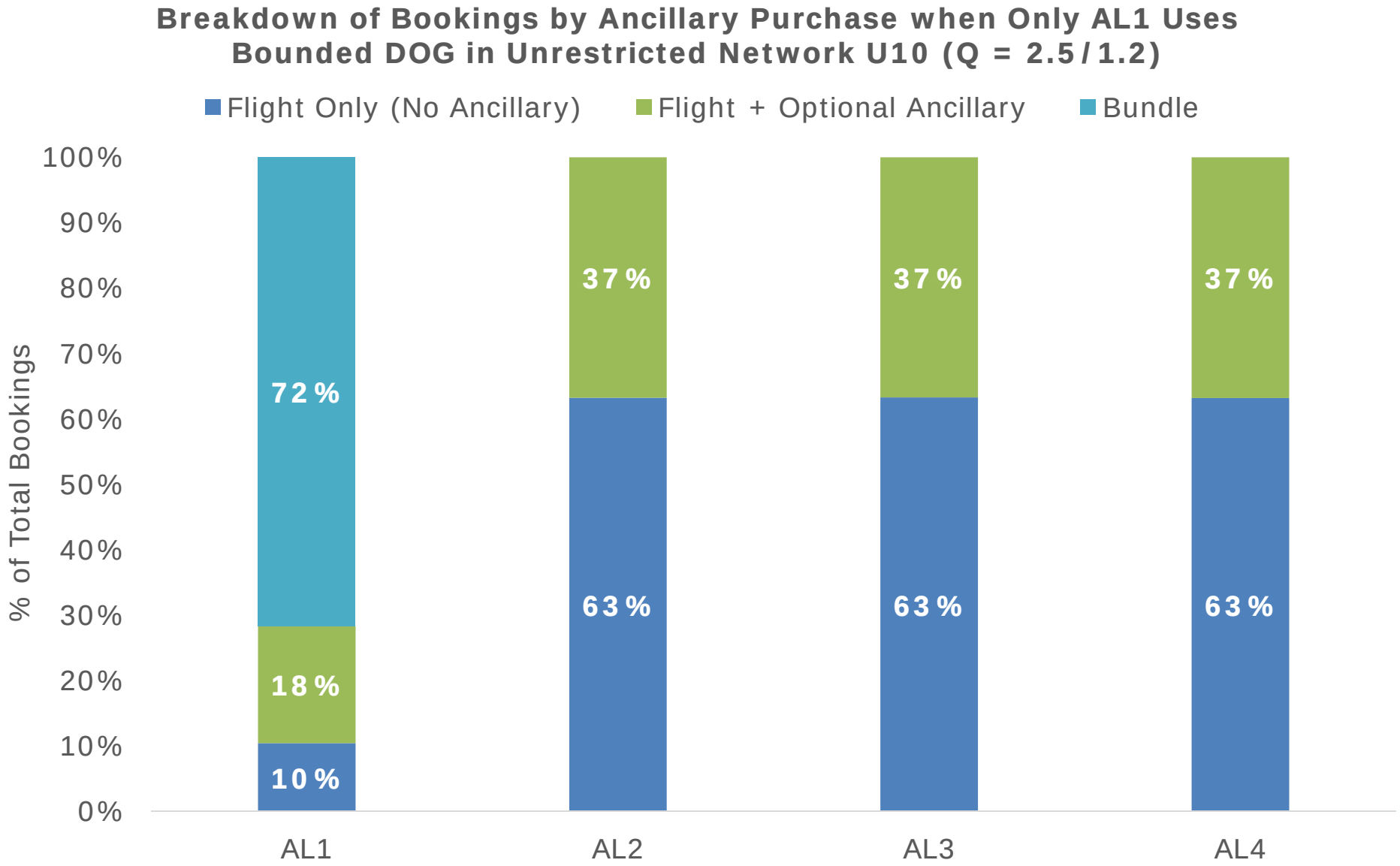


Courtesy: M. Wittman

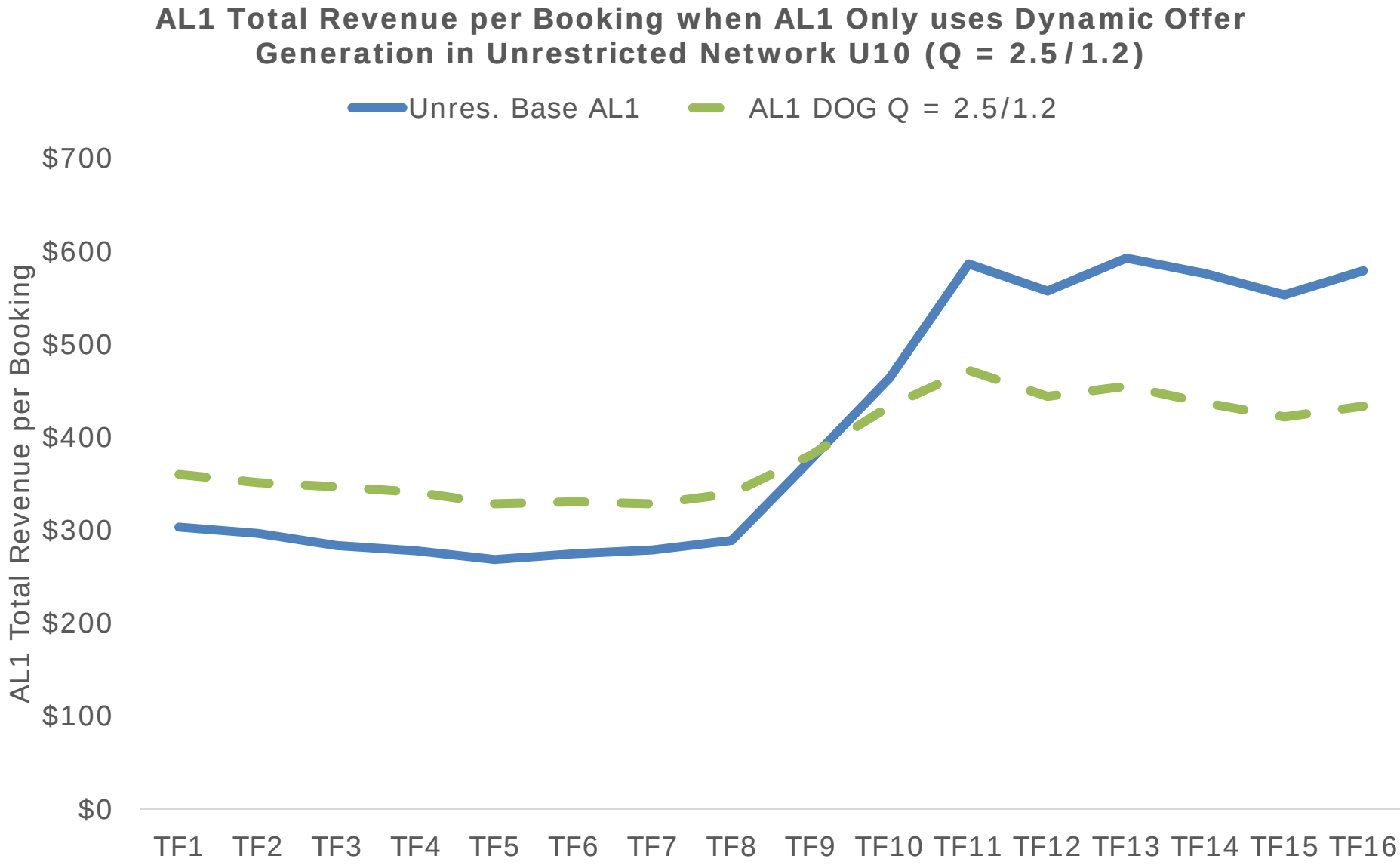
DOG is Revenue Positive When Used with Network RM by One or All Airlines in U10



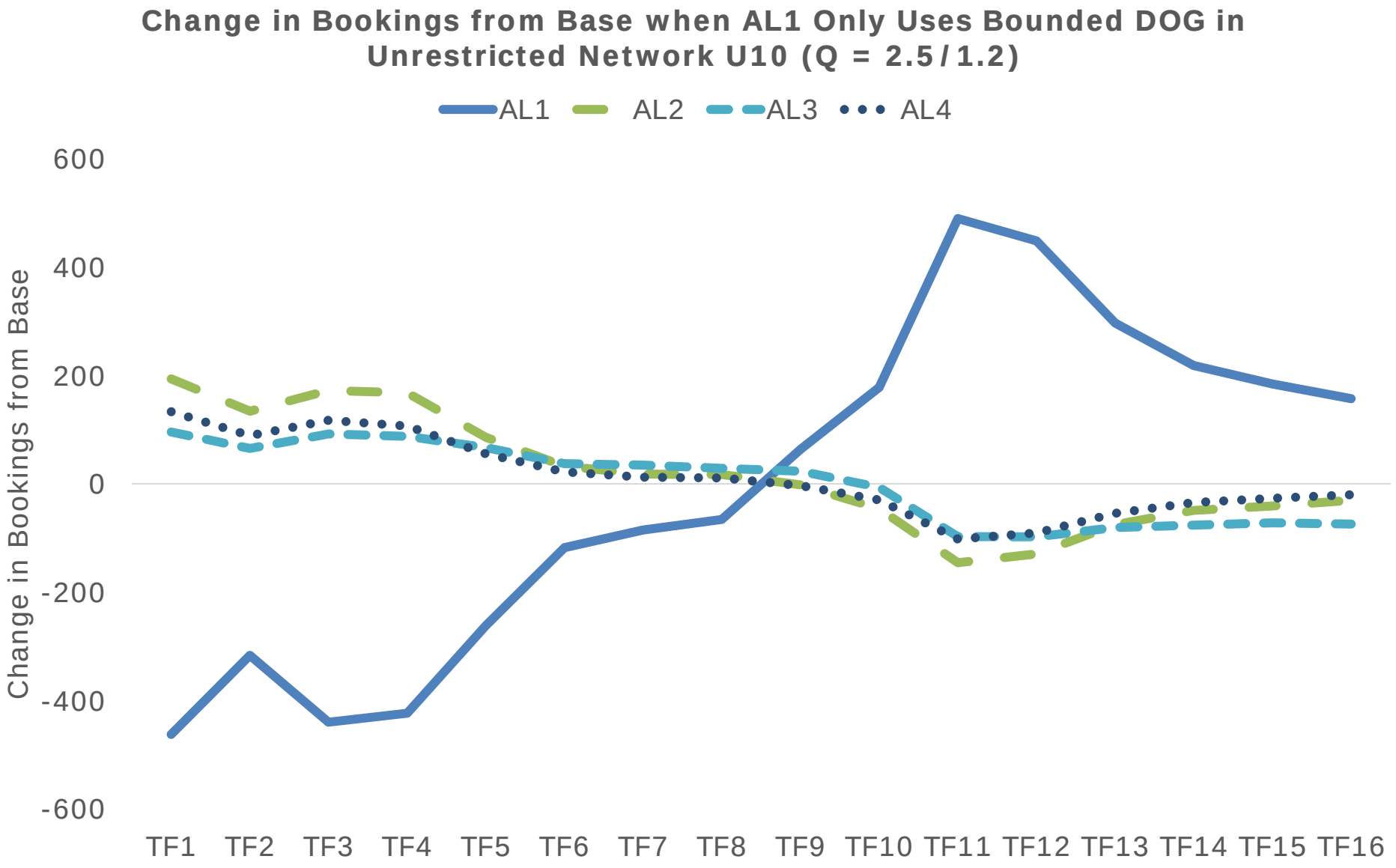
90% of AL1's Passengers End Up Receiving the Ancillary, Mostly Through Purchasing Bundles



For Airline 1 DOG Increases Total Revenue per Booking in Early TFs, Lowers It Closer to Departure



Competitors Capture More Bookings Early, but AL1 Gains Many Later Bookings with Lower Priced Offers



Industry Concern: Will Dynamic Pricing Cause a Race to the Bottom?

- Suppose two airlines offer identical flights in the same market:

- The "**race to the bottom**" refers to the incentive for each firm to undercut the other until one firm reaches its marginal cost.

AL1	AL2
~~$350~~	$350
$349	~~$350~~
~~$349~~	$348
$347	$348
⋮	⋮
$99	*$100 (MC)*

- This scenario is also called **Bertrand competition**, and would mean that firms price at marginal cost.

Rewards and Risks of Dynamic Pricing

- Our research has shown that adding dynamic pricing to traditional airline RM leads to several reward/risk tradeoffs:

Reward / Risk Tradeoffs from Dynamic Pricing

	Incrementing	Discounting
Rewards:	• Increase in yield • Reduction in buy-down • More producer surplus	• Gain new bookings • Increase in LF • Stimulate demand
Risks:	• Loss of bookings • OAL capture of business passengers	• Competitor reactions • Yield impacts • "Race to the bottom"

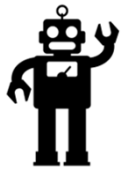
- PODS simulations suggest that if practiced carefully, dynamic pricing techniques could lead to revenue-positive performance even in competitive markets.

Preparing for a World with Next-Generation Airline Pricing

- The airline industry should proceed under the assumption that next-generation pricing will develop in some form.
- To prepare for next-generation pricing, airlines will need to develop new processes, techniques, and core competencies:

New RM estimation models for Conditional WTP

Automated processes for next-generation pricing



Interoperability with existing systems and practices

Corporate strategies for new pricing mechanisms