MIT International Center for Air Transportation

PRICING AND REVENUE MANAGEMENT RESEARCH
Airline Competition and Pricing Power

Presentations to
Industry Advisory Board Meeting
November 4, 2005

PRESENTATIONS

- **"Pricing and Competition in Top US Markets" (Celia Geslin)**
  - Fare, Traffic and Revenue Changes 2000 to 2004
- **"Impacts of Airline Fare Simplification" (Maital Dar)**
  - MIT PODS Research Consortium
  - Simulations of Revenue and Traffic Impacts
- **"Adapting Revenue Management Systems" (Peter Belobaba)**
  - Development of New Forecasting and Optimization Algorithms

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AIRLINE PRICING AND COMPETITION IN TOP US MARKETS

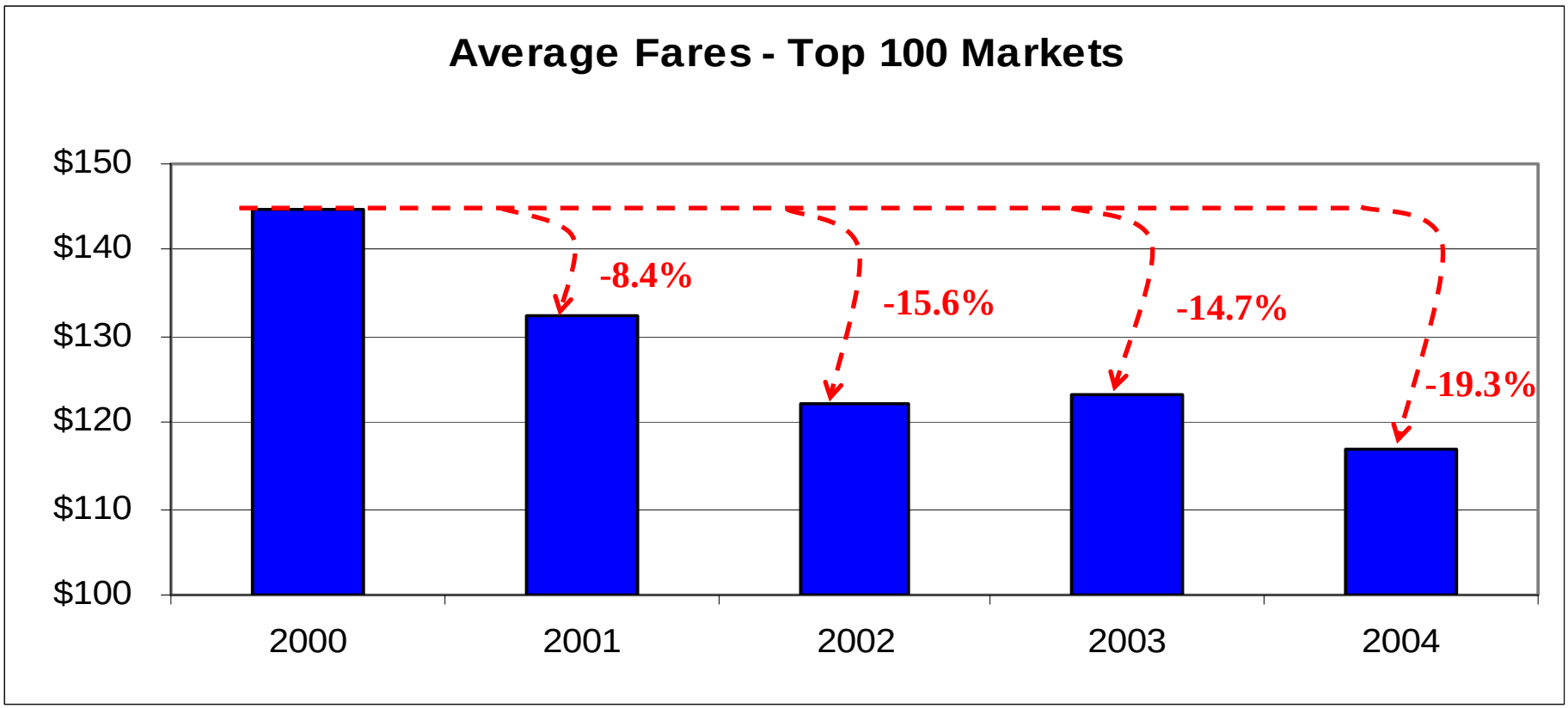
Célia Geslin

Objectives and Approach

- **Preliminary analysis of airline pricing power in US markets:**
  - How have air fares changed in domestic markets in the past 5 years?
  - Differences by length of haul?
  - Differences between LCC and non-LCC markets?
- **Empirical analysis of largest domestic markets**
  - Top 100 US 2004 Markets from O&D Plus Data
  - Aggregate analysis and overall trends between 2000 and 2004
  - Analysis by carrier and type of carrier (legacy, LCC)

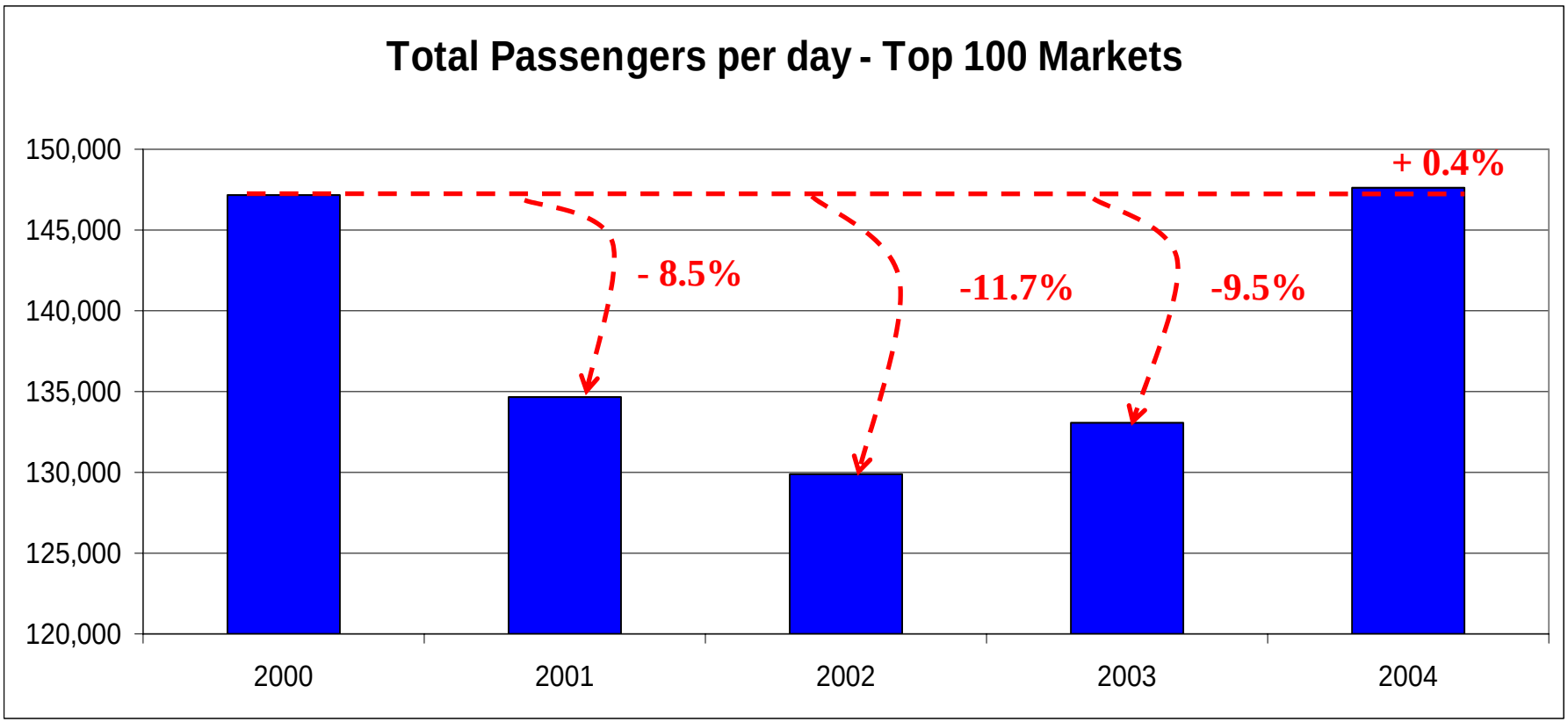
Average Fares in Top 100 US Markets

- Fares continue to decrease. On average, fares were 19.3% lower in 2004 compared to 2000.



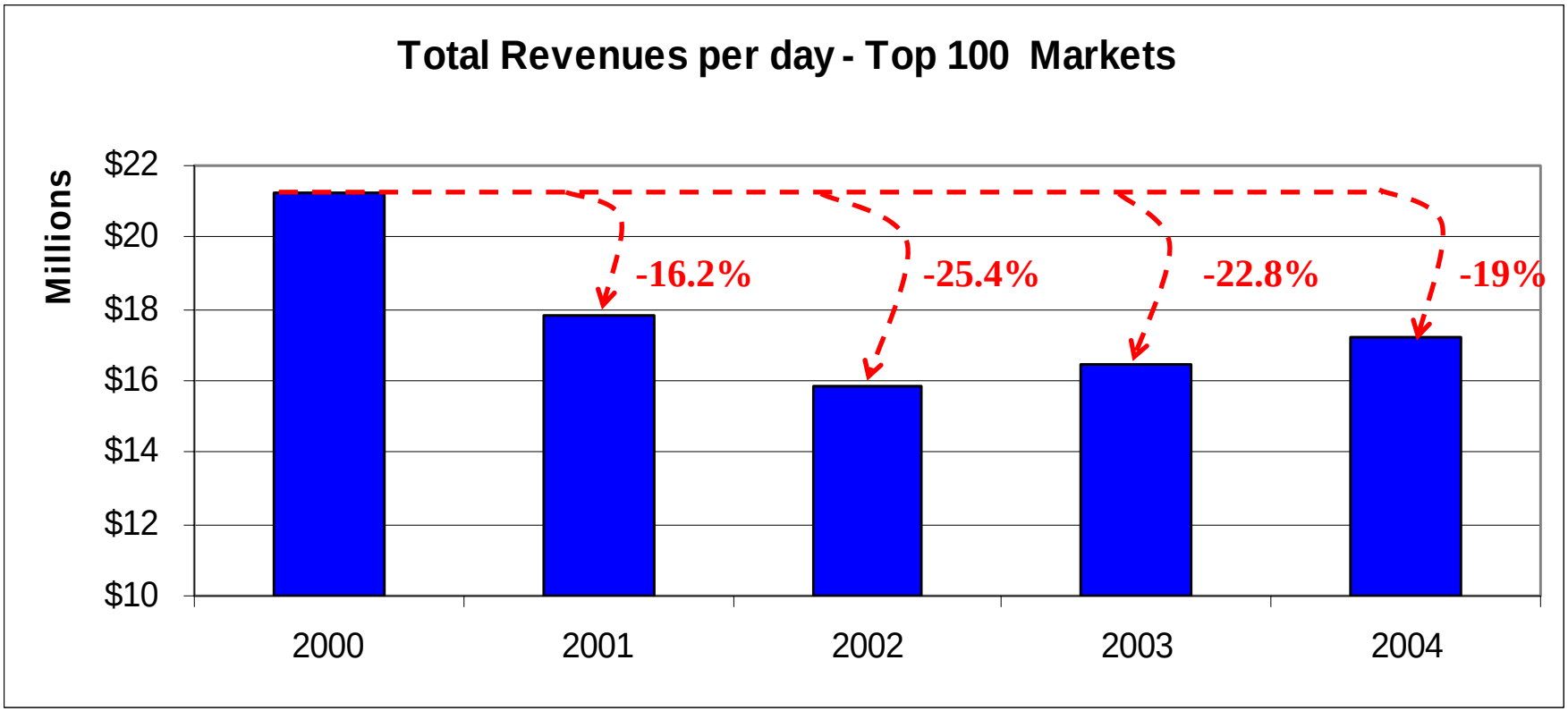
Total Passengers in Top 100 US Markets

- Passenger volumes have rebounded to 2000 levels after dropping by over 11%.



Total Revenues in Top 100 US Markets

- Huge revenue drop of 25.4% by 2002. Slow recovery since then, but still 19% below 2000.

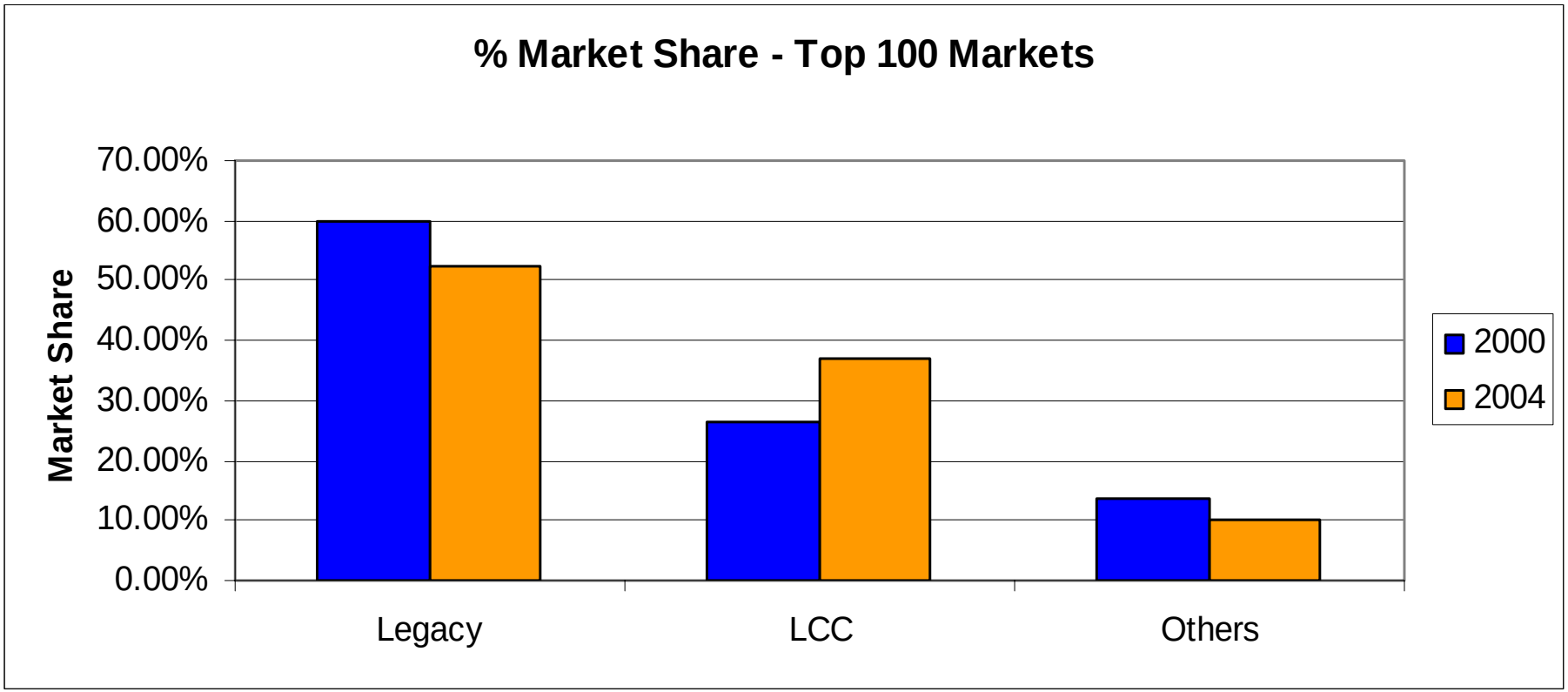


Carrier Market Share Losses and Gains

- Market share losses for network carriers, gains for LCCs – led by JetBlue
- Southwest is MS leader in Top 100 Markets, in both 2000 and 2004

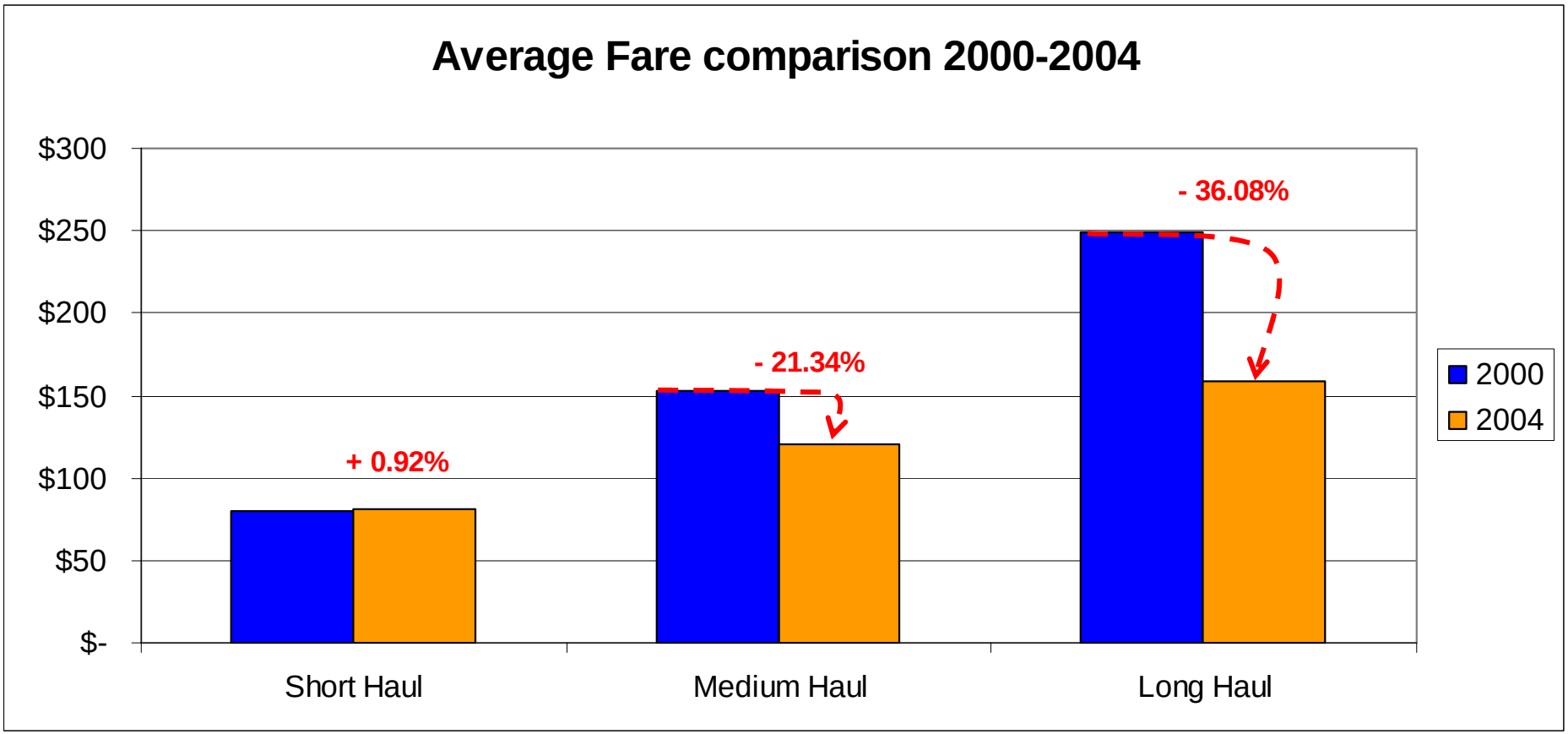
Market Share by Carrier Group

- Overall, LCC group MS increased from 26% to 37%, while Legacy group MS dropped from 60% to 53%



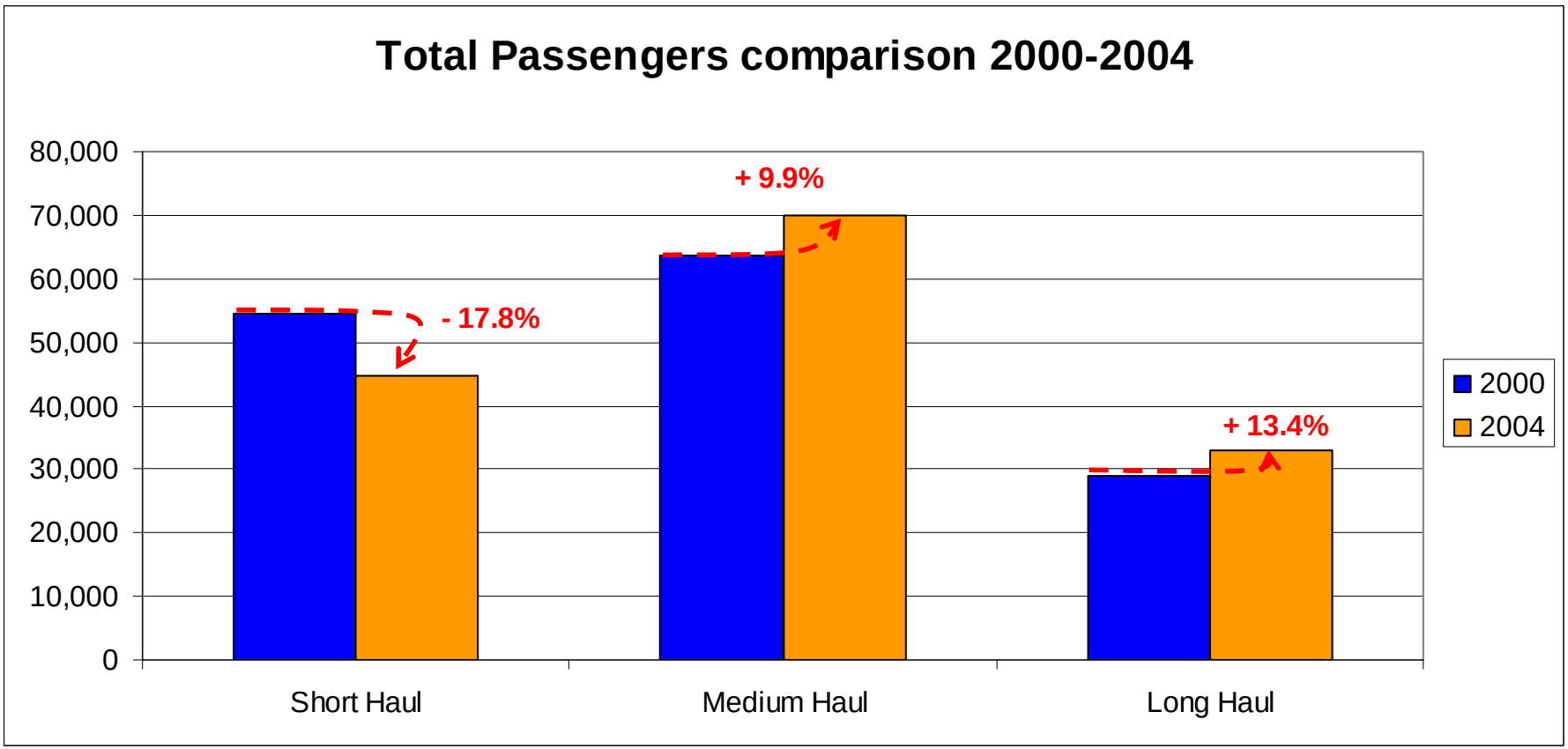
Fares by Distance Category

- Average fares have dropped by 36% in long haul markets, while short haul fares actually increased slightly compared with 2000.



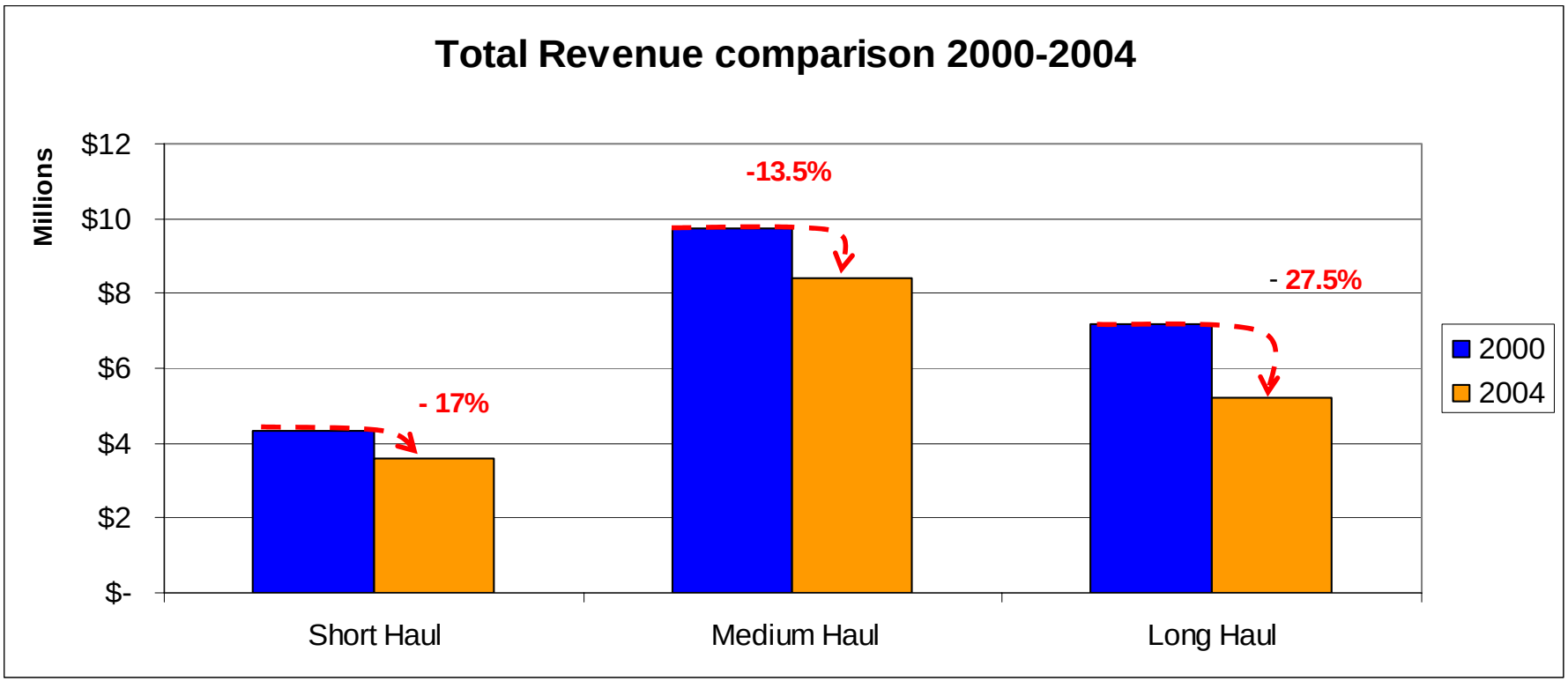
Passengers by Distance Category

- Passenger traffic in short haul markets dropped 18%, while increasing 10-13% in medium and long haul markets



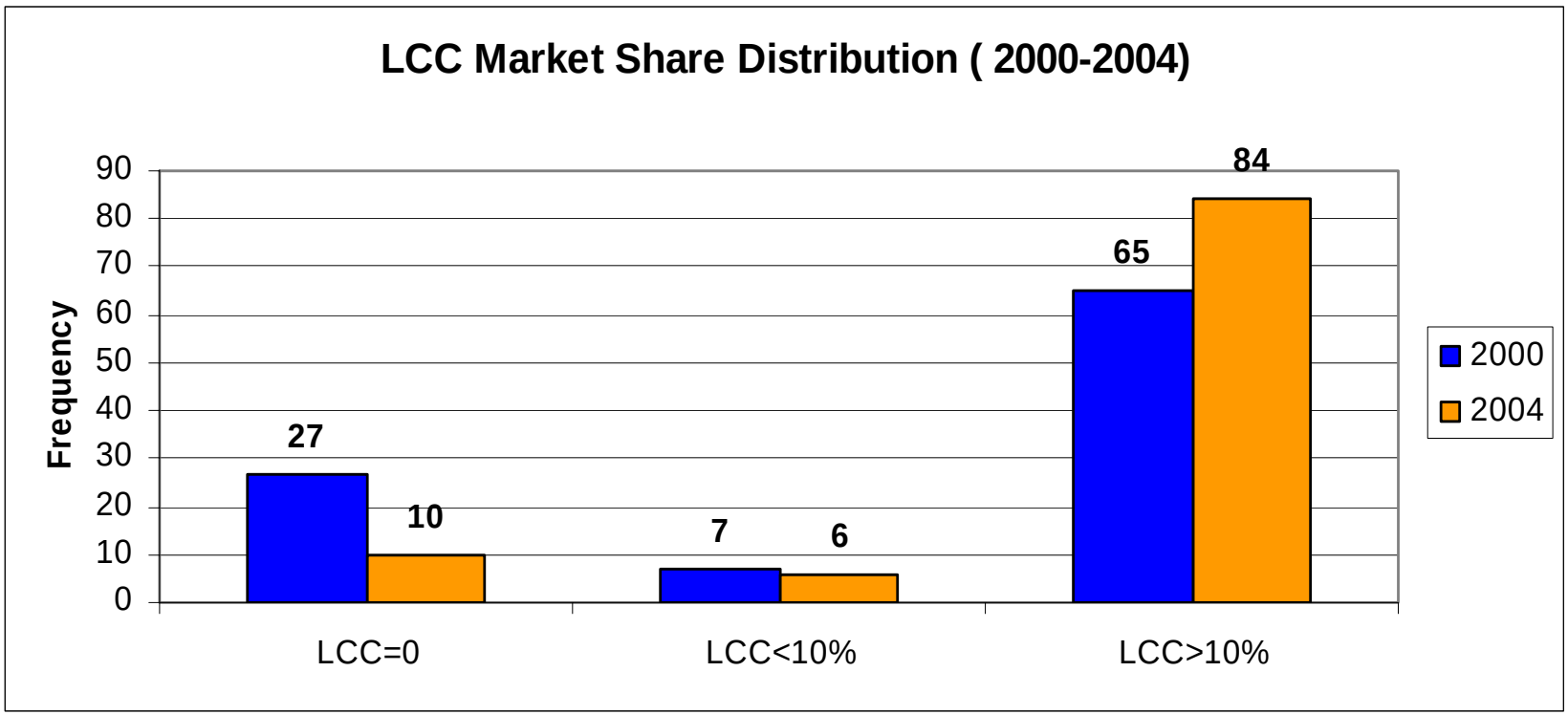
Revenues by Distance Category

- Total Revenues decreased most in long haul markets despite traffic growth – down 27% overall



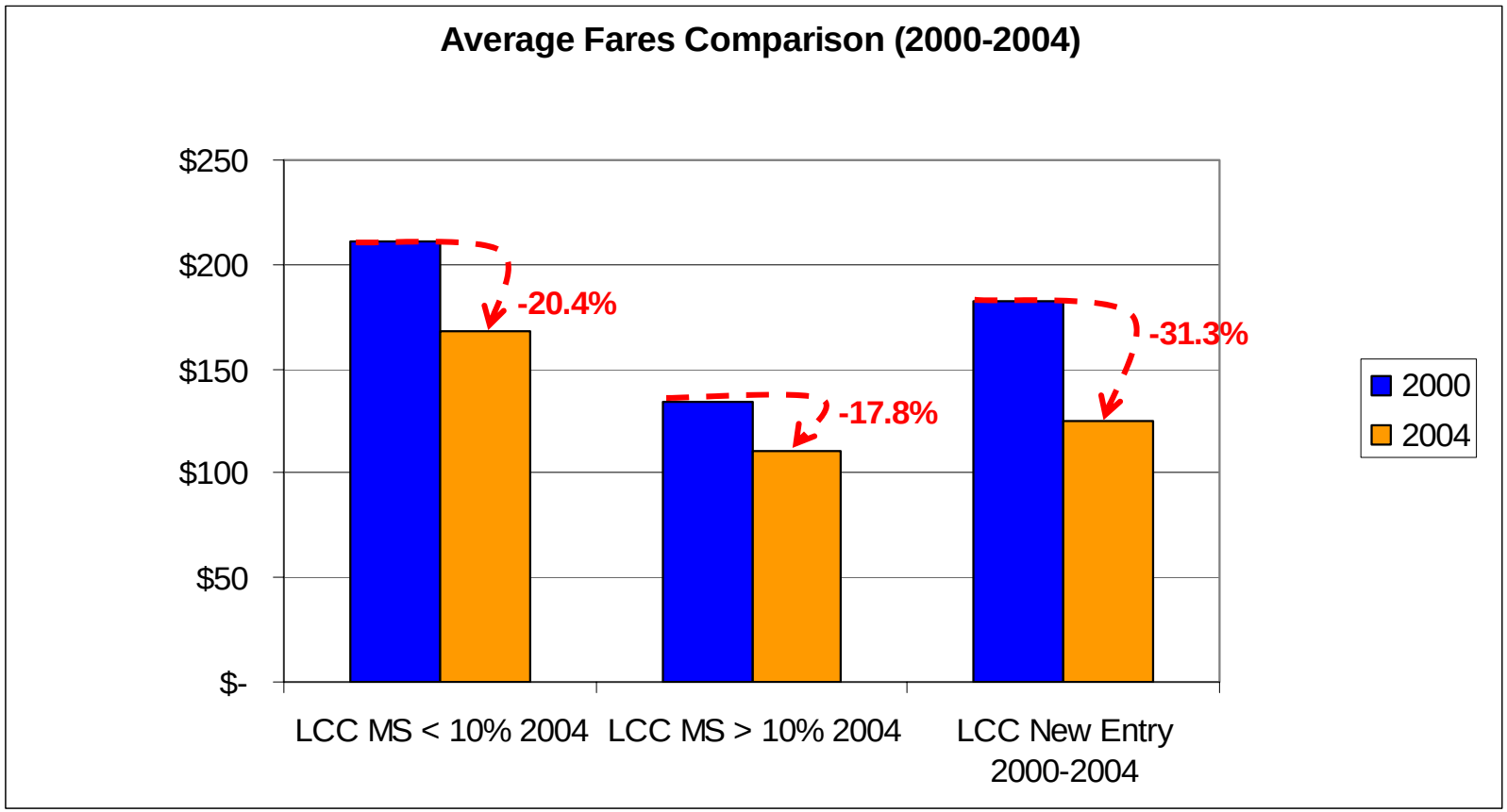
Markets Grouped by LCC Presence

- In 2000, 27 of Top 100 US Markets without LCC presence
- By 2004, only 10 Top 100 US Markets without LCC presence (6 when Hawaii markets excluded)
  - 84 of the Top 100 US Markets with more than 10% LCC MS



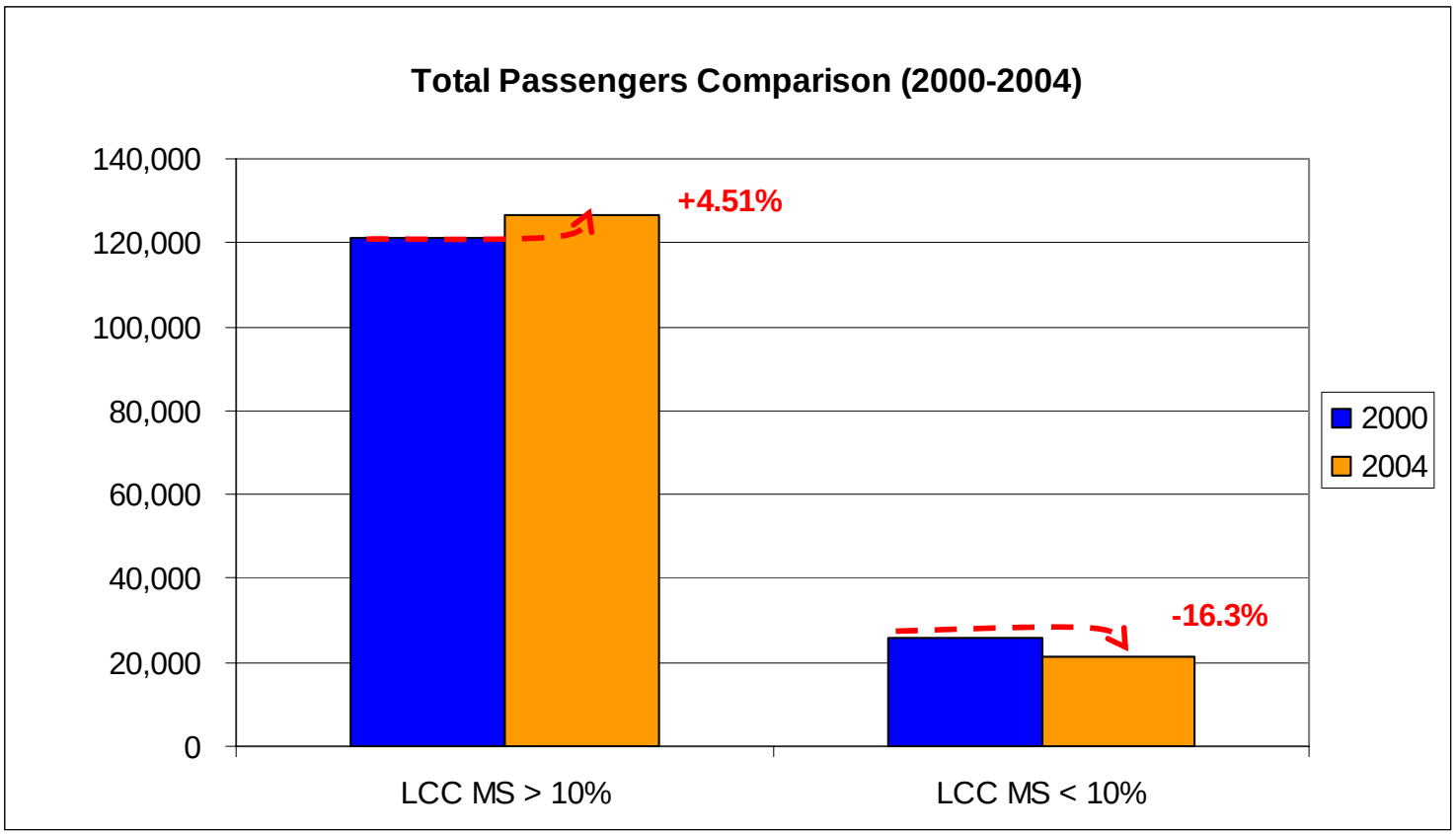
Average Fares and LCC Presence

- Average Fare decreased more for markets with a small 2004 LCC market share than the markets with well-established LCC presence.
- Largest (31%) decrease in fares observed for markets with new entry by LCC between 2000 and 2004.



Passenger Traffic and LCC Presence

- Markets with LCC presence showed traffic growth of 4.51%
- But in O&D markets with small or no LCC market share, traffic is still 16% below the 2000 level.



Conclusions: Top 100 Markets

- **Overall trends in largest US markets 2000-2004**
  - Traffic has rebounded to peak 2000 levels
  - But average fares have dropped 19%, with a corresponding total revenue decrease
- **Major differences identified:**
  - By carrier type – Legacy carriers have lost 5% market share and over 9% revenue share
  - Long-haul market fares have dropped the most, with greatest traffic growth. On the other hand, short-haul traffic is down, and average fares stable. Substantially lower total revenues in all distance categories.
  - Markets with LCC new entry saw the greatest drop in average fares between 2000 and 2004

Future Research

- **Expand the sample to 500 or 1000 Top US Markets**
- **Identify relevant factors in the evolution of pricing and competition in airline markets:**
  - Length of haul
  - Low-fare carrier competition
  - Hub vs. non-hub markets
- **Broader questions include:**
  - How has willingness to pay (price elasticity) changed? Are people less willing to pay for air travel?
  - How has airline pricing power been reduced? How can we quantify this effect?

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IMPACTS OF AIRLINE FARE SIMPLIFICATION

Maital Dar

PODS RM Research Consortium

- **Airline revenue management research at MIT funded in large part by PODS Research Consortium**
  - Focus on forecasting and optimization models for seat inventory control (seat allocation)
  - Findings used to help guide each airline's RM system development
- **Most member airlines have renewed; new member added in 2005**

Continental Airlines
Scandinavian Airlines System
Delta Air Lines
Air New Zealand
Lufthansa German Airlines
Northwest Airlines
KLM/Air France
LAN Airlines (new)

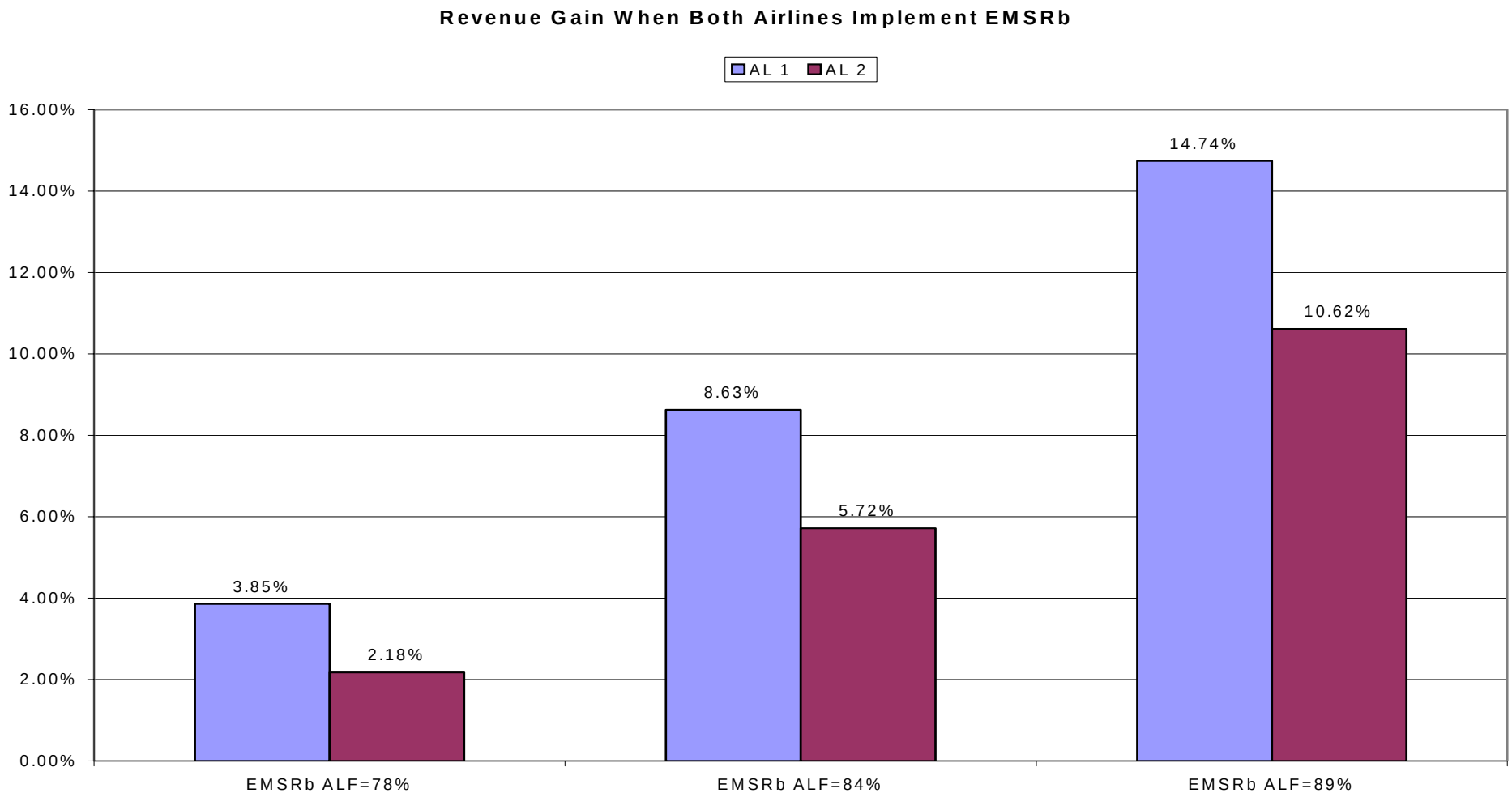
Tumbling Airline Revenues

- **Fares have been decreasing**
  - The lower fares are due in part to LFA competition, but not exclusively
  - RM system shortcomings are also involved
- **Passenger choice process has changed, but RM systems have not**
  - Airline customers have learned how to get cheaper fares, but existing revenue management systems in use largely don't take this new reality into account
- **Traditional RM systems all based on:**
  - Identifiable and independent demand for different fare products with restrictions associated with lower fares

BOS-SEA Traditional Fare Structure
American Airlines, October 2001

Roundtrip Fare ($)	Cls	Advance Purchase	Minimum Stay	Change Fee?	Comment
458	N	21 days	Sat. Night	Yes	Tue/Wed/Sat
707	M	21 days	Sat. Night	Yes	Tue/Wed
760	M	21 days	Sat. Night	Yes	Thu-Mon
927	H	14 days	Sat. Night	Yes	Tue/Wed
1001	H	14 days	Sat. Night	Yes	Thu-Mon
2083	B	3 days	none	No	2 X OW Fare
2262	Y	none	none	No	2 X OW Fare
2783	F	none	none	No	First Class

Simulation of Leg-Based RM Benefits
Differentiated Fare Structure



Fare Simplification: Less Restricted and Lower Fares

- **Recent trend toward "simplified" fares – compressed fare structures with fewer restrictions**
  - Initiated by low-fare airlines in many parts of the world
  - Early in 2005, implemented in all US domestic markets by Delta, matched selectively by legacy competitors
- **Simplified fare structures characterized by:**
  - Little or no minimum stay restrictions, but advance purchase and non-refundable/change fees
  - Lower fare ratios from highest to lowest published fares, typically no higher than 5:1 in affected US domestic markets

Example: BOS-ATL Simplified Fares
Delta Air Lines, September 2005

One Way Fare ($)	Bkg Cls	Advance Purchase	Minimum Stay	Change Fee?	Comment
$124	T	21 days	0	$50	Non-refundable
$139	U	14 days	0	$50	Non-refundable
$199	L	7 days	0	$50	Non-refundable
$224	K	3 days	0	$50	Non-refundable
$259	Q	0	0	$50	Non-refundable
$444	B	3 days	0	$50	Non-refundable
$494	Y	0	0	No	Full Fare
$294	A	0	0	No	First Class
$594	F	0	0	No	First Class

LEG RM SIMULATIONS: Impacts of Fare Restriction Removal

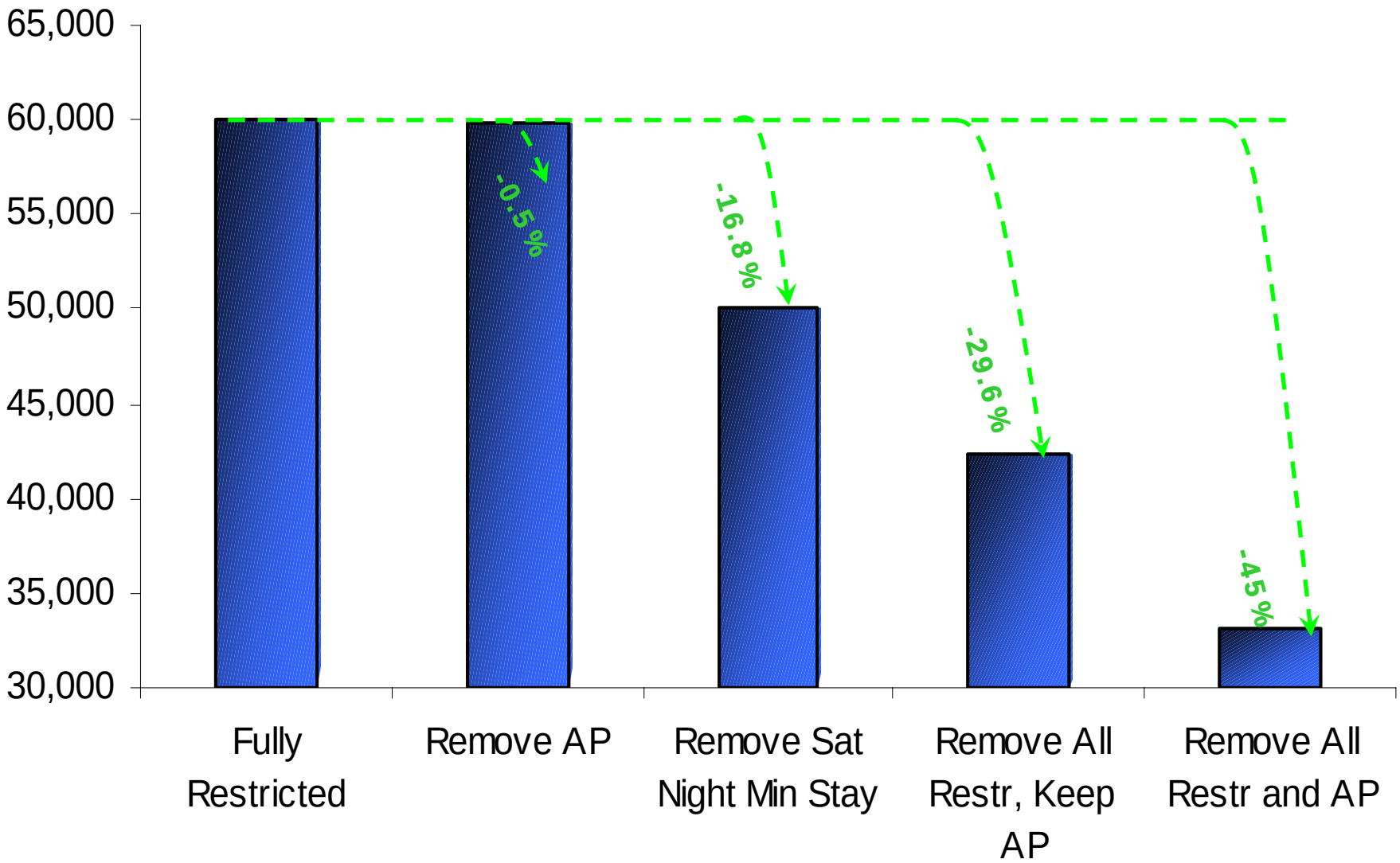
- 2 carriers, single market, both use EMSRb leg RM controls
- 6 fare classes, 3.5:1 fare ratio:

Class	1	2	3	4	5	6
Fare	**425.00**	**310.00**	**200.00**	**175.00**	**150.00**	**125.00**

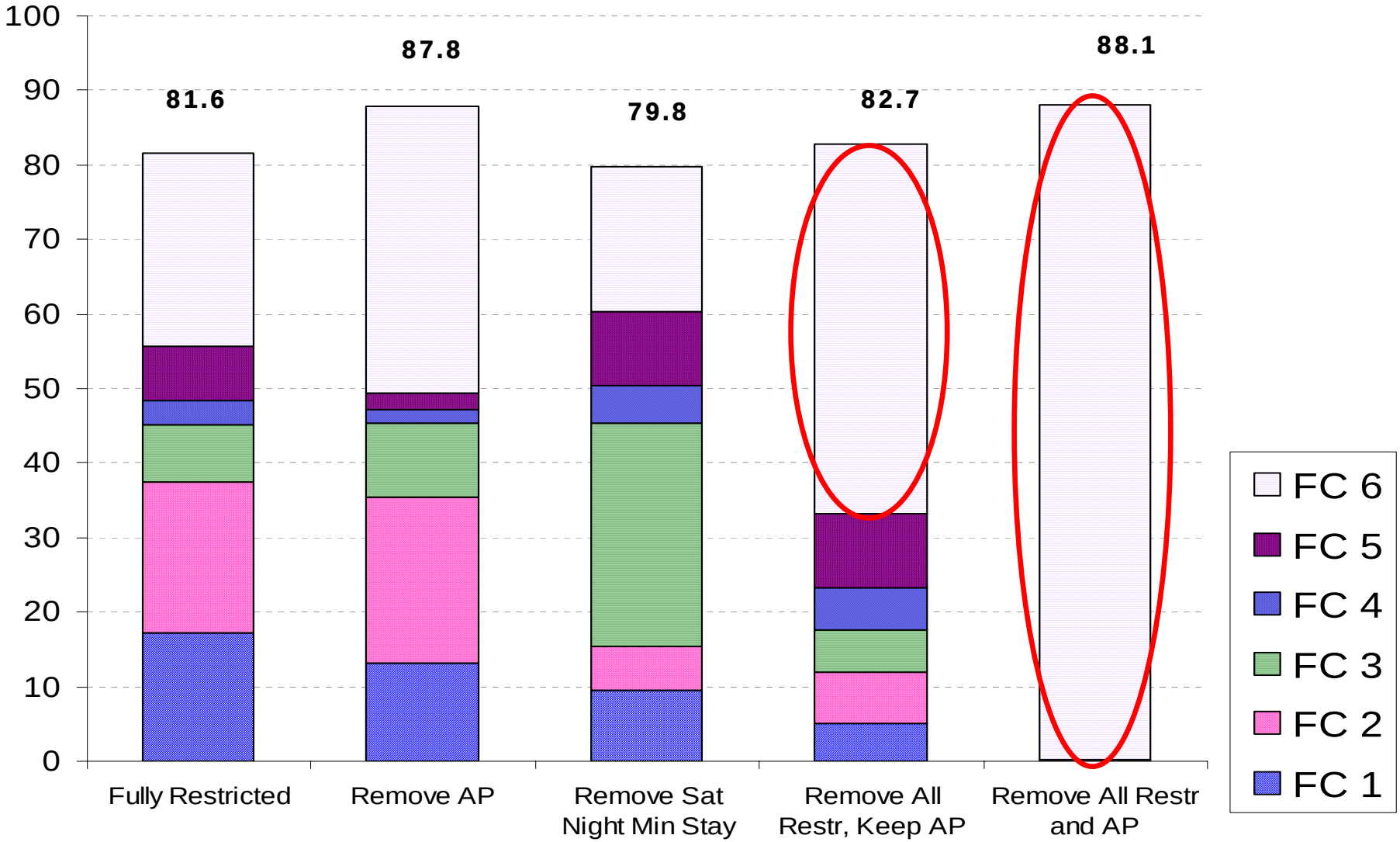
- BASE CASE: Restricted and Differentiated Fares

Fare Class	AP	MIN Sat Night	Chg Fee	Non-Refund
1	**0**	**0**	**0**	**0**
2	**3**	**0**	**1**	**0**
3	**7**	**1**	**0**	**0**
4	**10**	**1**	**1**	**0**
5	**14**	**1**	**1**	**1**
6	**21**	**1**	**1**	**1**

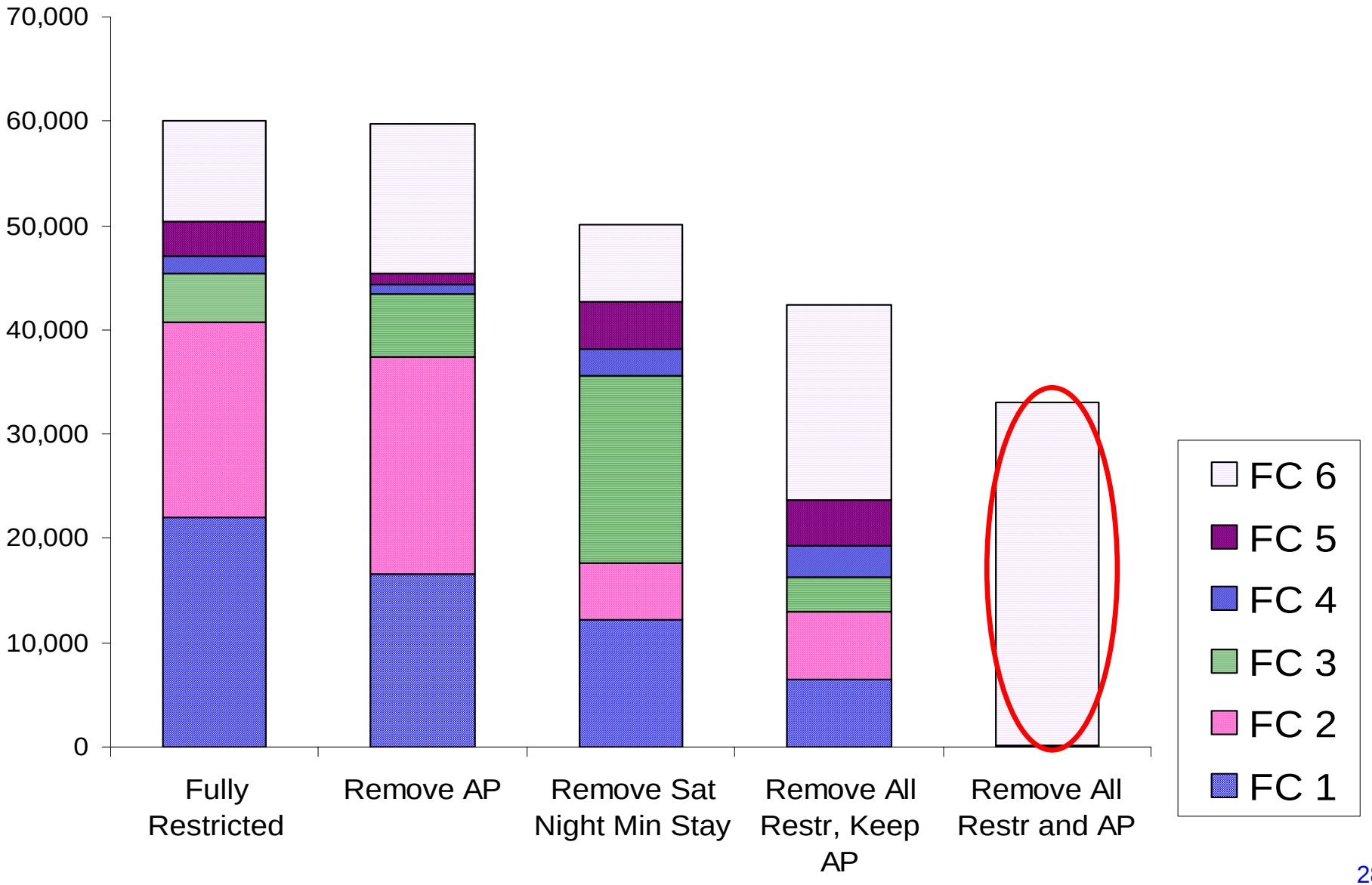
Revenue Impact of Each "Simplification"



Loads by Fare Class

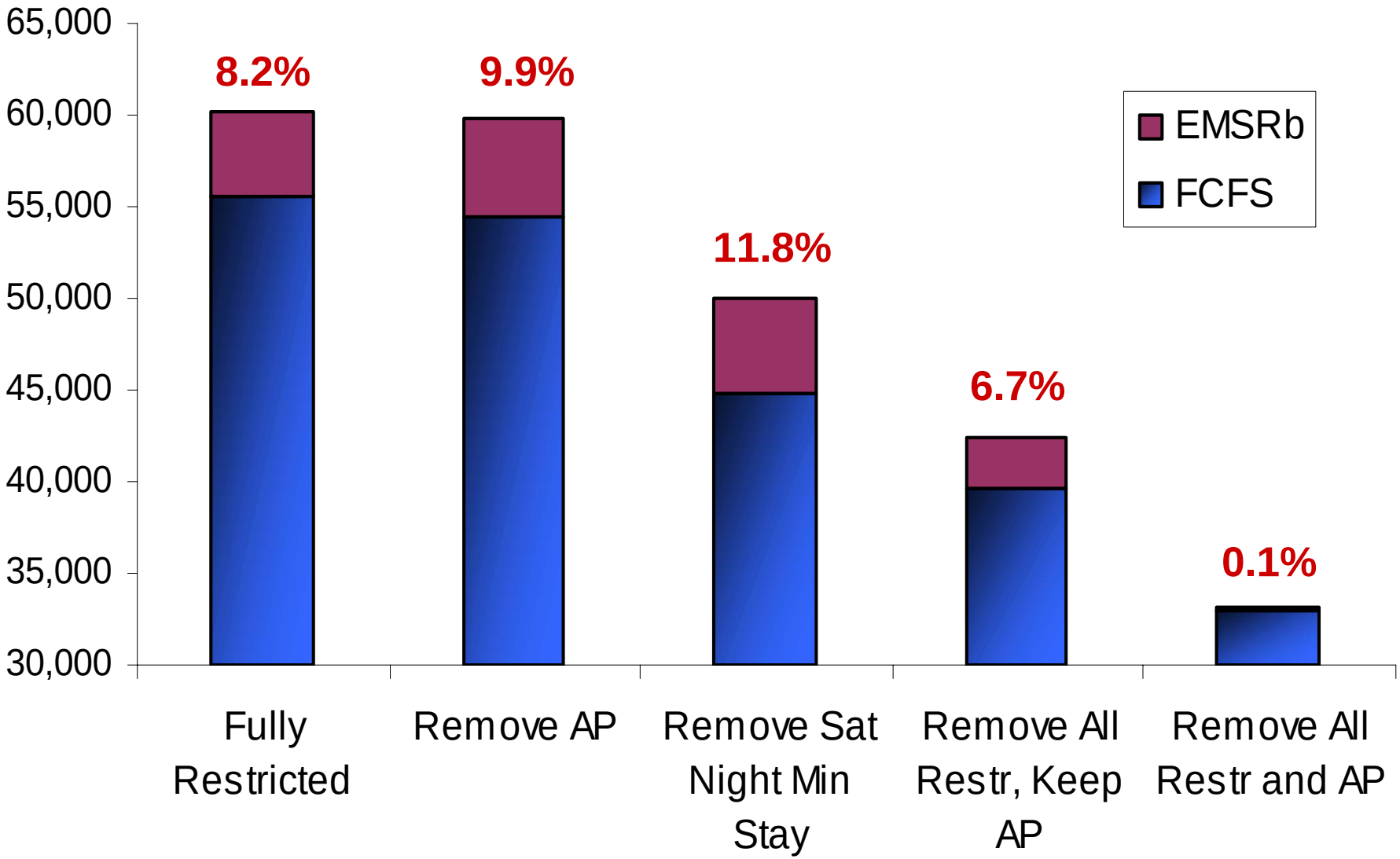


Revenues by Fare Class



Effectiveness of Traditional Leg RM

Percentage improvement over No RM Controls



Summary – Impacts of Fare Simplification

- **Simplified fares have contributed to large revenue losses for US airlines**
  - PODS simulated revenue losses in line with 15% impacts quoted by airlines
- **Fare class mix is also affected**
  - "Simplified" fare structures have changed the types of products passengers buy
- **The fundamental assumptions of RM systems:**
  - Are no longer appropriate under changing conditions
  - May even be hurting airline revenues

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ADAPTING RM SYSTEMS AND MODELS

Peter Belobaba

Existing Airline RM Systems Need to be Modified for Changing Fare Structures

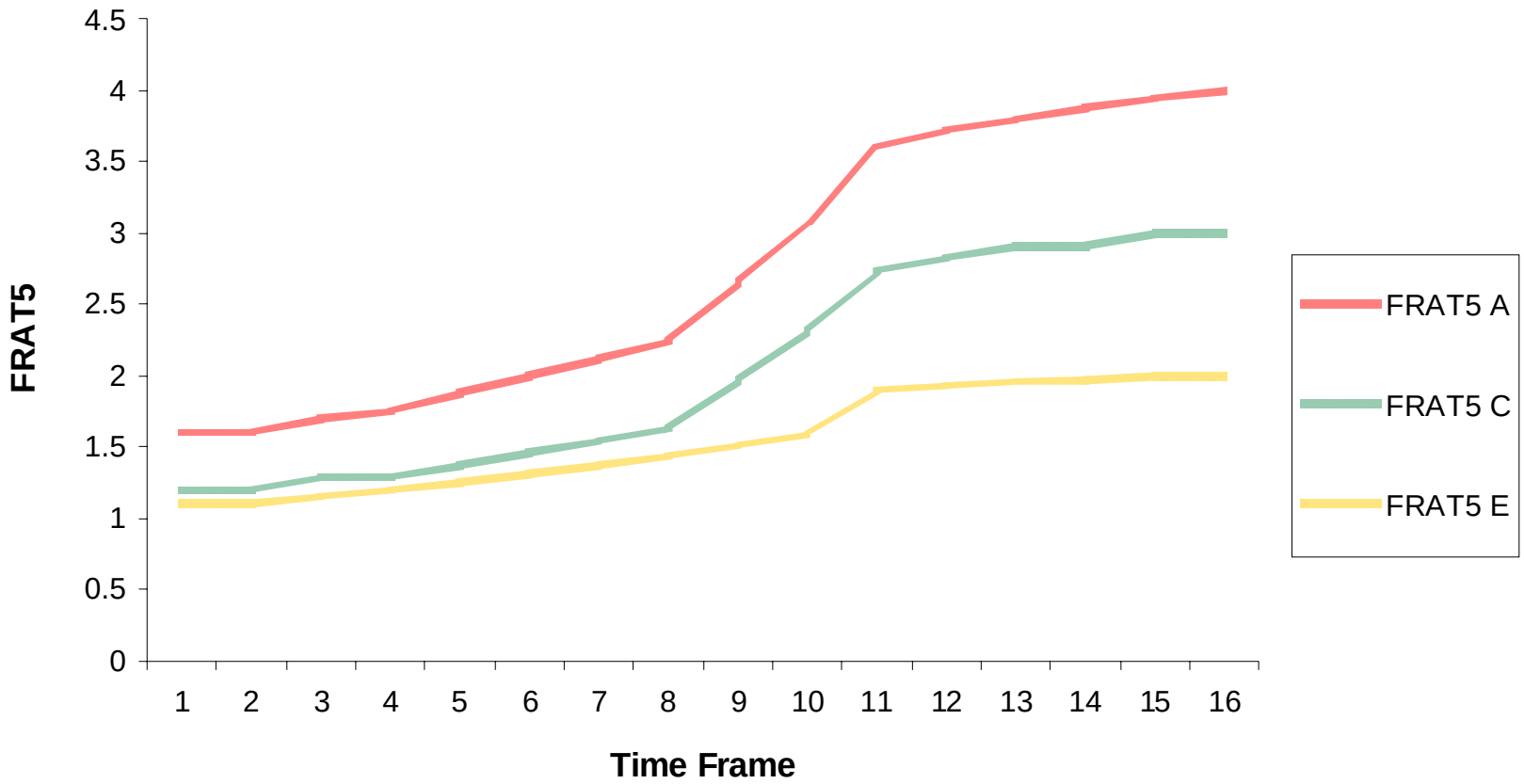
- **RM systems were developed for restricted fares**
  - Assumed independent fare class demands, because restrictions kept full-fare passengers from buying lower fares
- **Without modification, these RM systems <u>will not maximize revenues</u> in less restricted fare structures**
  - Unless demand forecasts are adjusted to reflect potential sell-up, high-fare demand will be consistently under-forecast
  - Optimizer then under-protects, allowing more "spiral down"
- **RM system limitations are affecting airline revenues**
  - Existing systems, left unadjusted, generate high load factors but do not increase yields

Models for Undifferentiated Fares

- **Need to forecast demand by willingness to pay (WTP) higher fares with same restrictions (i.e., sell-up)**
- **"Q-forecasting" approach requires estimates of passenger WTP by time to departure for each flight**
  - Approach is to forecast maximum demand potential at lowest (Q) fare, and convert into "partitioned" forecasts for each fare class
- **Then, modified WTP forecasts can be fed as demand inputs to RM optimizers:**
  - Standard EMSRb for Leg-based RM
  - Dynamic Programming methods
  - Network optimization methods for O+D Controls

Example of Expected WTP Behavior

- Typical values exhibit an S-shape reflecting the changing business/leisure mix across time frames



Hybrid Forecasting For Simplified Fare Structures

- **Separate forecasts for price and product oriented demand**
  - A passenger is counted as ***price-oriented*** if the next lower class from the one booked is closed
  - A passenger is counted as ***product-oriented*** if the next lower class from the one booked was open.

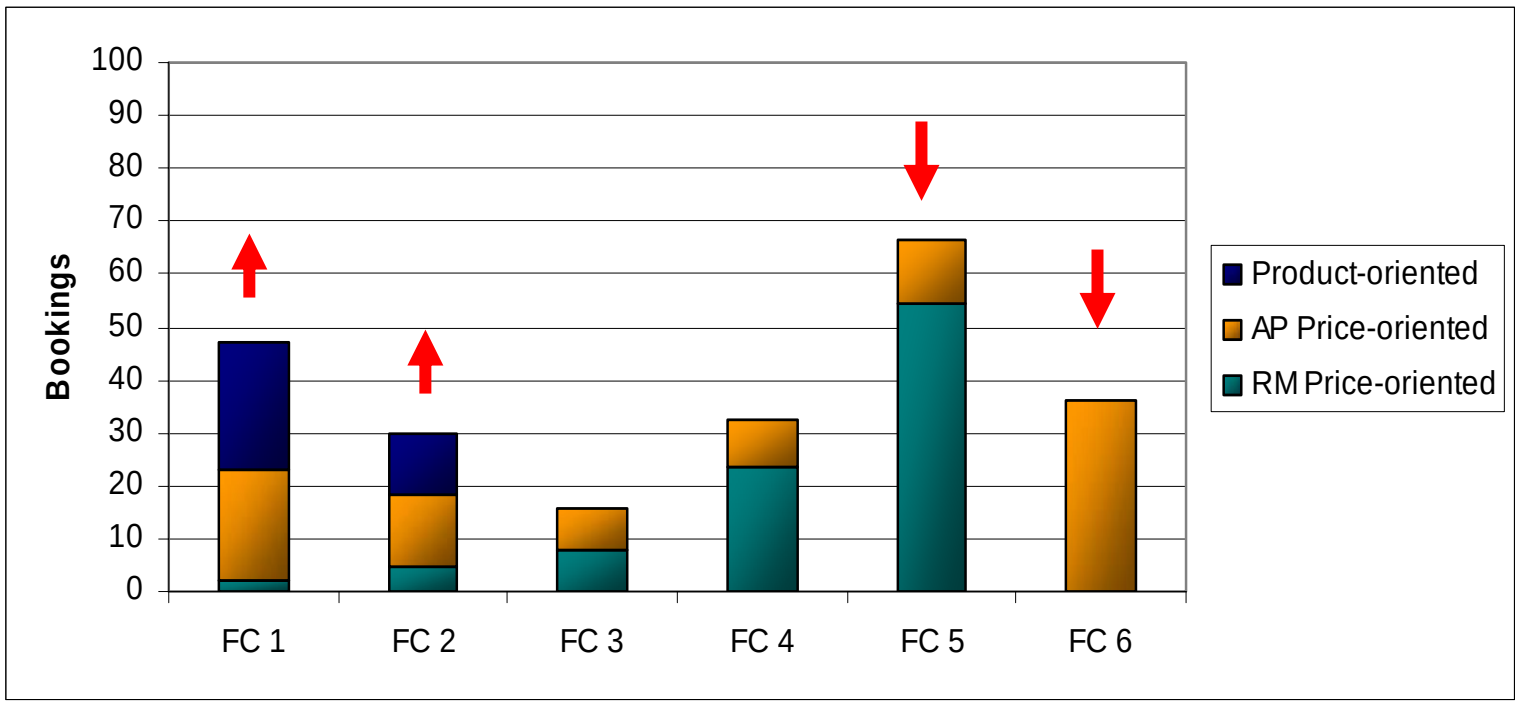
- **Combine standard RM forecasts and WTP forecasts**
  - For product-oriented demand, bookings are treated as a historical data for the given class, and standard time series forecasting applied.
  - For price-oriented demand, forecasts by WTP based on expected sell-up behavior
  - Combined forecasts fed into optimizers

Impacts of Hybrid Forecasting

Airline 1 Hybrid Forecasting and EMSRb

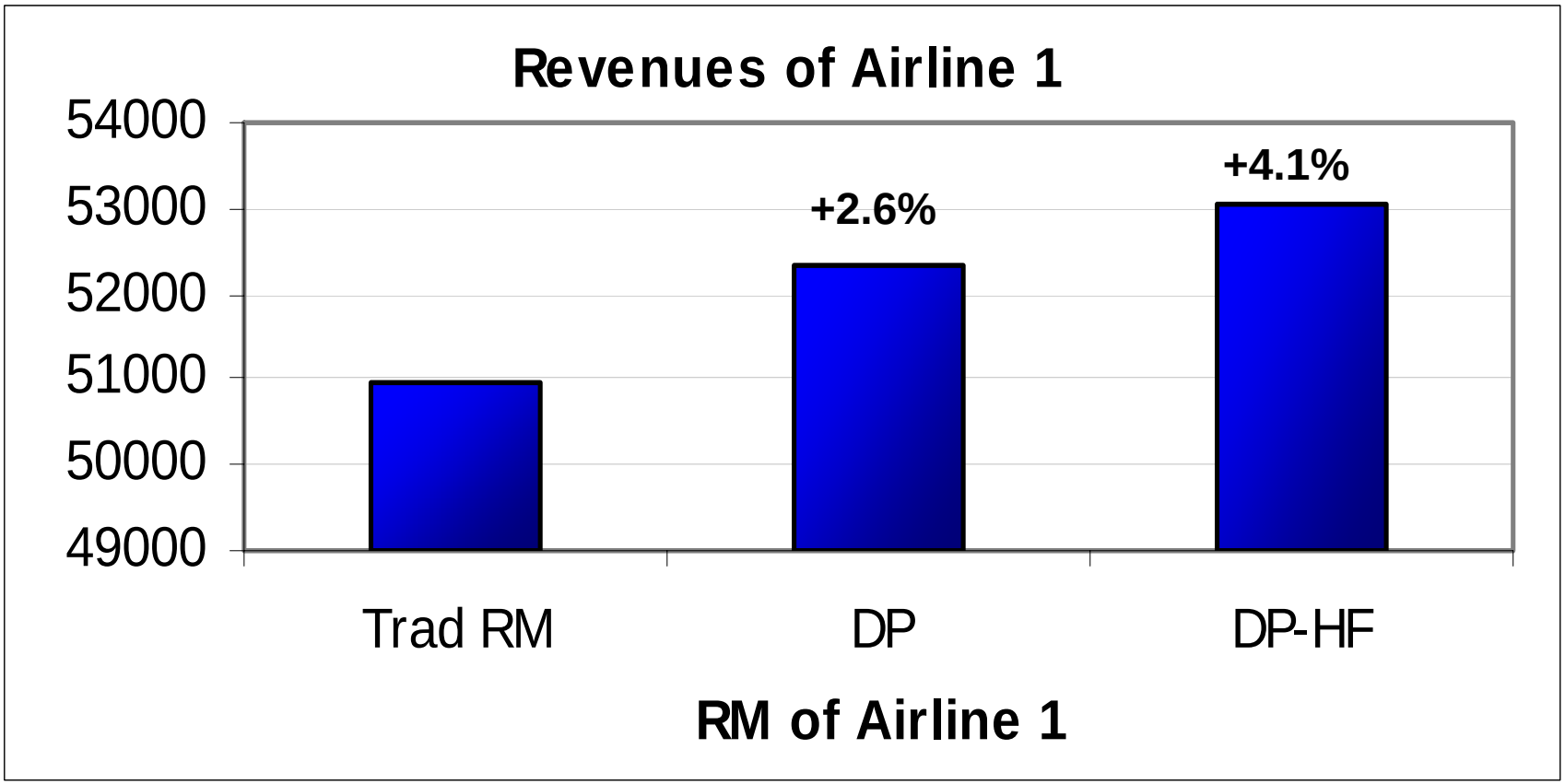
Airline 2 Standard Pick-up Forecasting and EMSRb

- Airline 1 revenues increase by 1.36%, with greater protection for higher classes and fewer seats sold in classes 5 and 6, leading to lower Load Factor

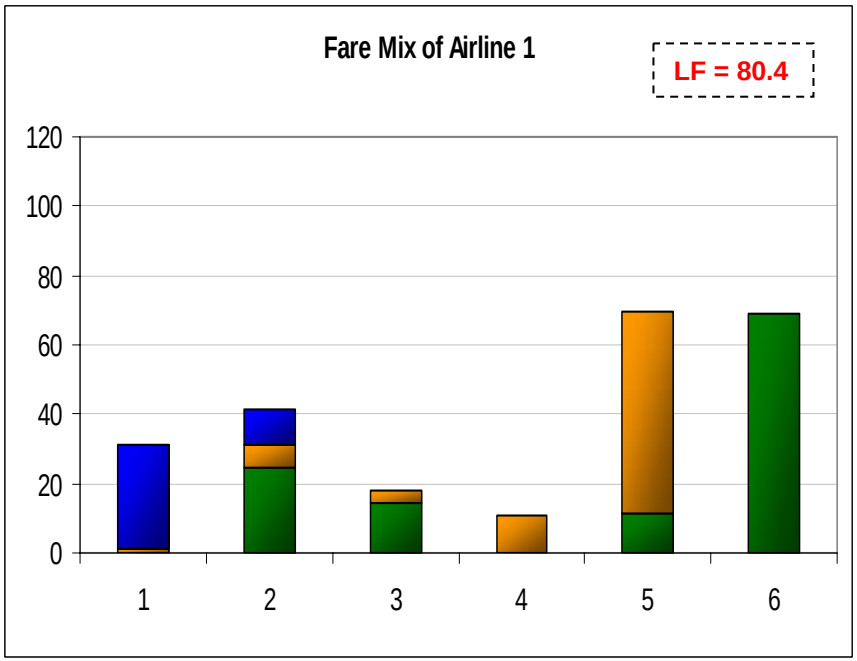


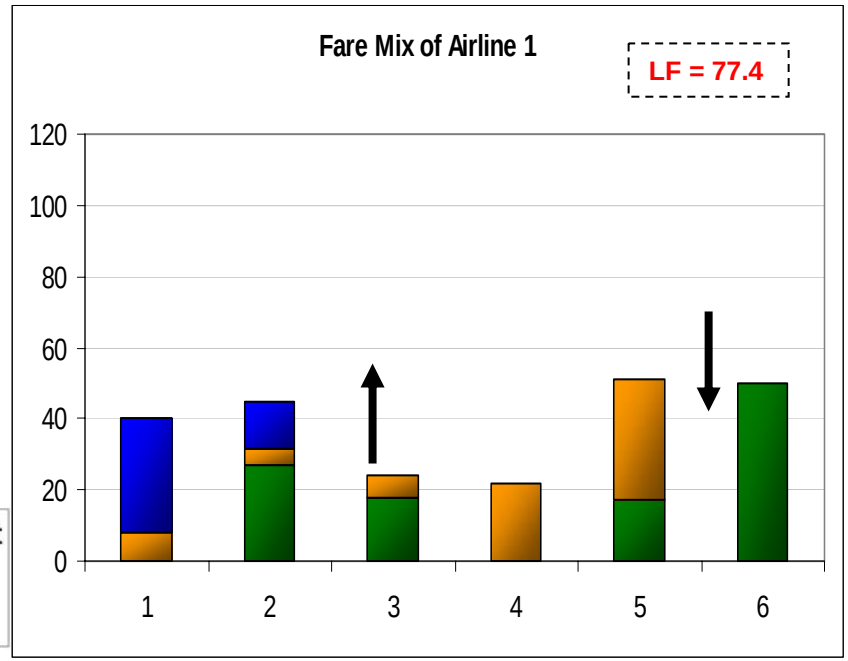
New Forecasting and Optimization for Simplified Fare Structures

- **Combining Hybrid Forecasting and Dynamic Programming (DP) for optimization of seat inventory further improves revenues.**



Impact on Fare Class Mix: DP w/HF





Traditional RM

DP w/ Hybrid Forecasts

DP with hybrid forecasting increases revenues by capturing more high yield passengers in middle and upper classes.

Conclusions: RM Systems in "Simplified" Fare Structures

- **Relaxed fare restrictions increase the importance of effective RM controls to airline revenues**
  - But, traditional RM methods do not maximize revenues
  - Modifications required to better forecast consumer choice
- **New approaches to "hybrid" forecasting of price- vs. product-oriented demand show good potential**
  - Incremental revenue gains over traditional RM methods
- **Need to estimate passenger WTP, affected by competitor's RM method and seat availability**
  - Focus of current research is how to actually *ESTIMATE* these values, required to generate the modified forecasts