TURKISH AVIATION ACADEMY

İTÜ

İSTANBUL TEKNİK ÜNİVERSİTESİ 1773

Network, Fleet and Schedule Strategic Planning

Alex Heiter & Bruce Tecklenburg

Istanbul Technical University

Air Transportation Management

M.Sc. Program

Network, Fleet and Schedule

Strategic Planning

30 March 2015

Introductions

- **This week's instructors:**

Alex Heiter

Director – Airline Network & Fleet Planning

Boeing Commercial Airplanes

alex.heiter@boeing.com

Dr. Peter Belobaba

Principle Research Scientist – International Center for Air Transportation

Massachusetts Institute of Technology

belobaba@mit.edu

Bruce Tecklenburg

Senior Manager – Airline Network & Fleet Planning

Boeing Commercial Airplanes

bruce.tecklenburg@boeing.com

Michael Wittman

Aviation Consultant

InterVistas

wittman@mit.edu

Introductions

- **ITU Student Introductions:**
  - Your Name
  - Your position in Turkish Airlines
  - What do you hope to learn from this course?

Course Syllabus & Requirements

DAY/TIME	LECTURE TOPICS
MONDAY 30 MARCH	
1000-1115	**1. Course Introduction and Airline Industry Overview (Boeing)** TEXTBOOK: Chapter 1 (1-13)
1115-1145	Morning Break
1145-1300	**2. Airline Current Business Environment (Boeing)**
1300-1400	Lunch
1400-1515	**3. World/Europe/Middle East Capacity Analysis (Boeing)**
1515-1530	Short Break
1530-1645	**4. "The Transformation of a Legacy Carrier – A Case Study of Turkish Airlines" – Erkan Dursun (IATA)** READING: The Transformation of a Legacy Carrier - A Case Study of Turkish Airlines", Journal of Air Transport Management 40-2014 (106-118)
1645-1700	Short Break
1700-1800	**5. Airline Network Strategies (Boeing)**

Course Syllabus & Requirements

TUESDAY 31 MARCH

1000-1115	**6. Overview of Airline Planning Process (Boeing)** TEXTBOOK: Chapter 3 (47-51)
1115-1145	Morning Break
1145-1300	**7. Introduction to Fleet Planning (Boeing)** TEXTBOOK: Chapter 6 (153-156)
1300-1400	Lunch
1400-1515	**8. Evaluation of Alternative Aircraft Types (Boeing)** *TEXTBOOK: Chapter 6 (156-162)*
1515-1530	Short Break
1530-1645	**9. Fleet Evaluation and Financial Analysis (Boeing)**
1645-1700	Short Break
1700-1800	ASSIGNMENT 1 – FLEET PLANNING (Boeing/Wittman)

Course Syllabus & Requirements

WEDNESDAY 1 APRIL

1000	**ASSIGNMENT 1 DUE**
1000-1115	**10. Fundamentals of Airline Markets and Demand (Belobaba)** TEXTBOOK: Chapter 3 (51-67)
1115-1145	Morning Break
1145-1300	**11.Estimation of Demand and Market Share (Belobaba)** TEXTBOOK: Chapter 3 (67-71)
1300-1400	Lunch
1400-1500	ASSIGNMENT 1 REVIEW and DISCUSSION (Boeing/Wittman)
1500-1515	Short Break
1515-1630	12.**Airline Operating Costs (Belobaba)** TEXTBOOK: Chapter 5 (113-122, 132-146)
1630-1645	Short Break
1645-1800	13.**Airline Network Structures (Belobaba)** TEXTBOOK: Chapter 6 (162-168)

Course Syllabus & Requirements

THURSDAY 2 APRIL

1000-1115	**14. Route Planning and Profit Evaluation (Belobaba)** TEXTBOOK: Chapter 6 (168-173) ARTICLE: Baldanza, B., Measuring Airline Profitability
1115-1145	Morning Break
1145-1300	**15. Modeling Passenger Choice of Flight Options (Belobaba)**
1300-1400	Lunch
1400-1515	**16.Overview of Boeing Planning Tools (Boeing)**
1515-1530	Short Break
1530-1645	**17. Airline Schedule Development (Belobaba)** TEXTBOOK: Chapter 6 (173-181)
1645-1700	Short Break
1700-1800	ASSIGNMENT 2 – ROUTE PROFIT EVALUATION (Wittman) Begin team work on assignment.

Course Syllabus & Requirements

FRIDAY 3 APRIL

1000	**ASSIGNMENT 2 DUE**
1000-1115	**18. Demand, Load and Spill Analysis (Belobaba)**
1115-1145	Morning Break
1145-1300	**19. Fleet Assignment (Belobaba)** TEXTBOOK: Chapter 7 (185-192) ARTICLE: Coldstart: Fleet Assignment at Delta Air Lines
1300-1400	Lunch
1400-1500	ASSIGNMENT 2 REVIEW and DISCUSSION (Wittman)
1500-1515	Short Break
1515-1630	**20. From Planning to Operations (Belobaba)** TEXTBOOK: Chapter 9 (253-269)
1630-1645	Short Break
1645-1800	ASSIGNMENT 3 – FLEET ASSIGNMENT/SCHEDULING (Wittman) Begin team work on assignment.

Course Syllabus & Requirements

SATURDAY 4 APRIL

1000	**ASSIGNMENT 3 DUE**
1000-1115	**21. Route Forecasting Process (Boeing)**
1115-1130	Morning Break
1145-1300	**22. Evolution of Airline Revenue Management (Belobaba)** TEXTBOOK: Chapter 4 (88-101)
1300-1400	Lunch
1400-1500	ASSIGNMENT 3 REVIEW and DISCUSSION (Wittman)
1500-1515	Short Break
1515-1630	**23.Network Revenue Management: O&D Control (Belobaba)** TEXTBOOK: Chapter 4 (101-108)
1630-1645	Short Break
1645-1800	**24.New Developments in RM Forecasting and Optimization (Belobaba)** TEXTBOOK: Chapter 4 (108-110)

COURSE GRADING

3 Team Assignments (during class week)	45%
Final Exam	55%

TURKISH AVIATION ACADEMY

İTÜ

Introduction: Airline Industry Overview

Bruce Tecklenburg

Istanbul Technical University

Air Transportation Management

M.Sc. Program

Network, Fleet and Schedule

Strategic Planning

Module 1: 30 March 2015

Lecture Outline

- **Airline Terminology and Measures**
  - Historical Trends in Industry Growth
- **Global Deregulation and Liberalization**
  - Impacts on Airline Competition
  - Evolution of LCC Business Models
- **Overview of World Airlines**
  - Largest Global Airlines

Airline Terminology and Measures

- **Airline Demand**

  RPK = Revenue Passenger Kilometer

  - ➔ One paying passenger transported 1 kilometer

  Yield = Revenue per RPK

  - ➔ Average fare paid by passengers, per kilometer flown

- **Airline Supply**

  ASK = Available Seat Kilometer

  - ➔ One aircraft seat flown 1 kilometer

  Unit Cost = Operating Expense per ASK (“CASK”)

  - ➔ Average operating cost per unit of output

- **Load Factor = RPK / ASK**
- **Unit Revenue = Revenue/ASK (“RASK”)**

Example: Airline Measures

- **A 200-seat aircraft flies 1000 kilometers, with 140 passengers:**

  RPK = 140 passengers X 1000 kilometers = 140,000

  ASK = 200 seats X 1000 kilometers = 200,000

- **Assume total revenue = $16,000; total operating expense = $15,000:**

  Yield = $16,000 / 140,000 RPK = $0.114 per RPK

  Unit Cost = $15,000 / 200,000 ASK = $0.075 per ASK

  Unit Revenue = $16,000 / 200,000 ASK = $0.080 per ASK

- **Load Factor = RPK / ASK**

  LF = 140,000 / 200,000 = 70.0%

  - ➔ For single flight, also defined as passengers / seats

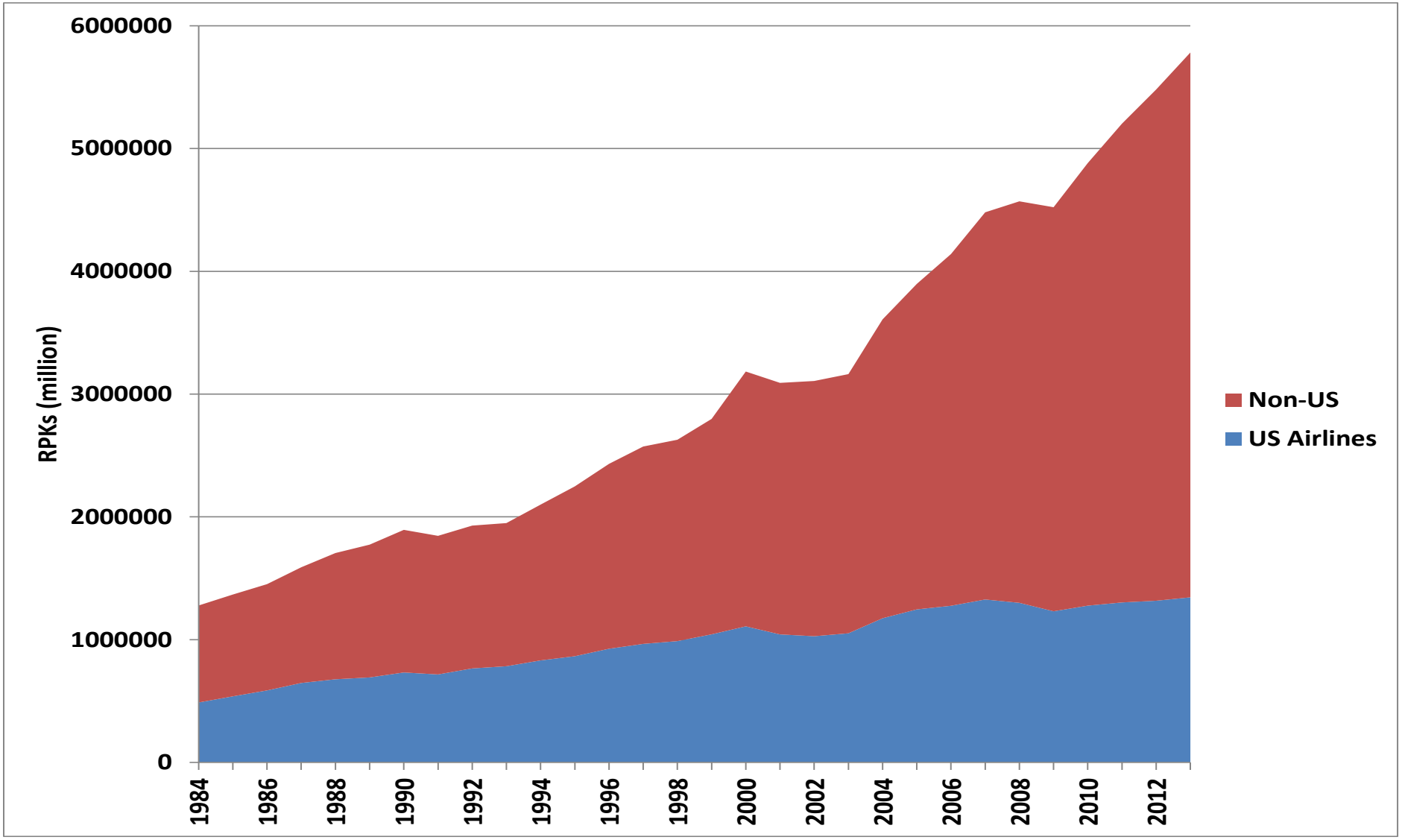
Additional Measures for Air Cargo

- ***Freight Tonne Kilometer (FTK)***
  Measure of freight traffic carried
  = freight tonnes carried X kilometers flown

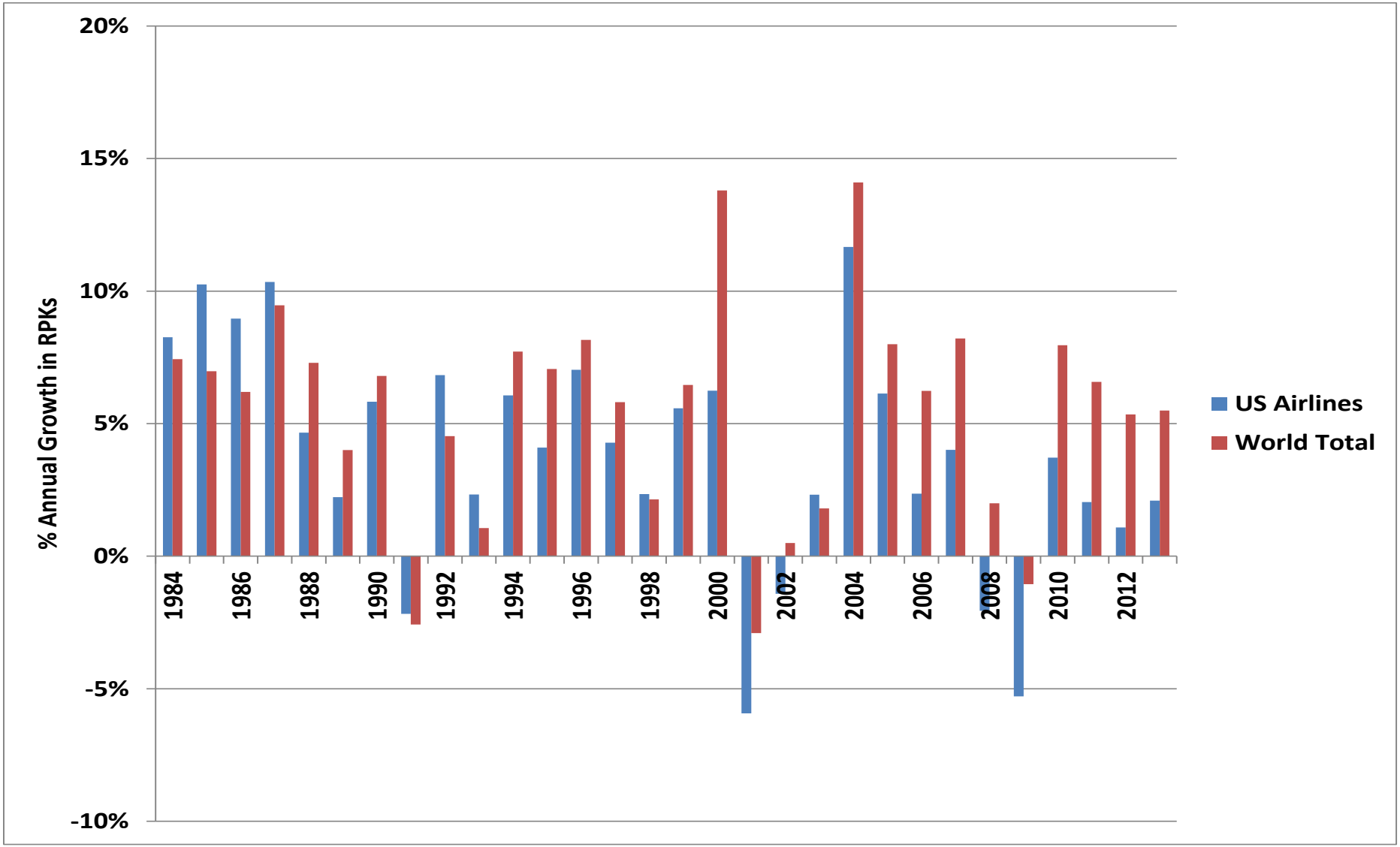
- ***Available Tonne Kilometer (ATK)***
  Measure of freight capacity available
  = freight tonne capacity X kilometers flown

- **Cargo Load Factor = FTK / ATK**
  - % of freight capacity utilized

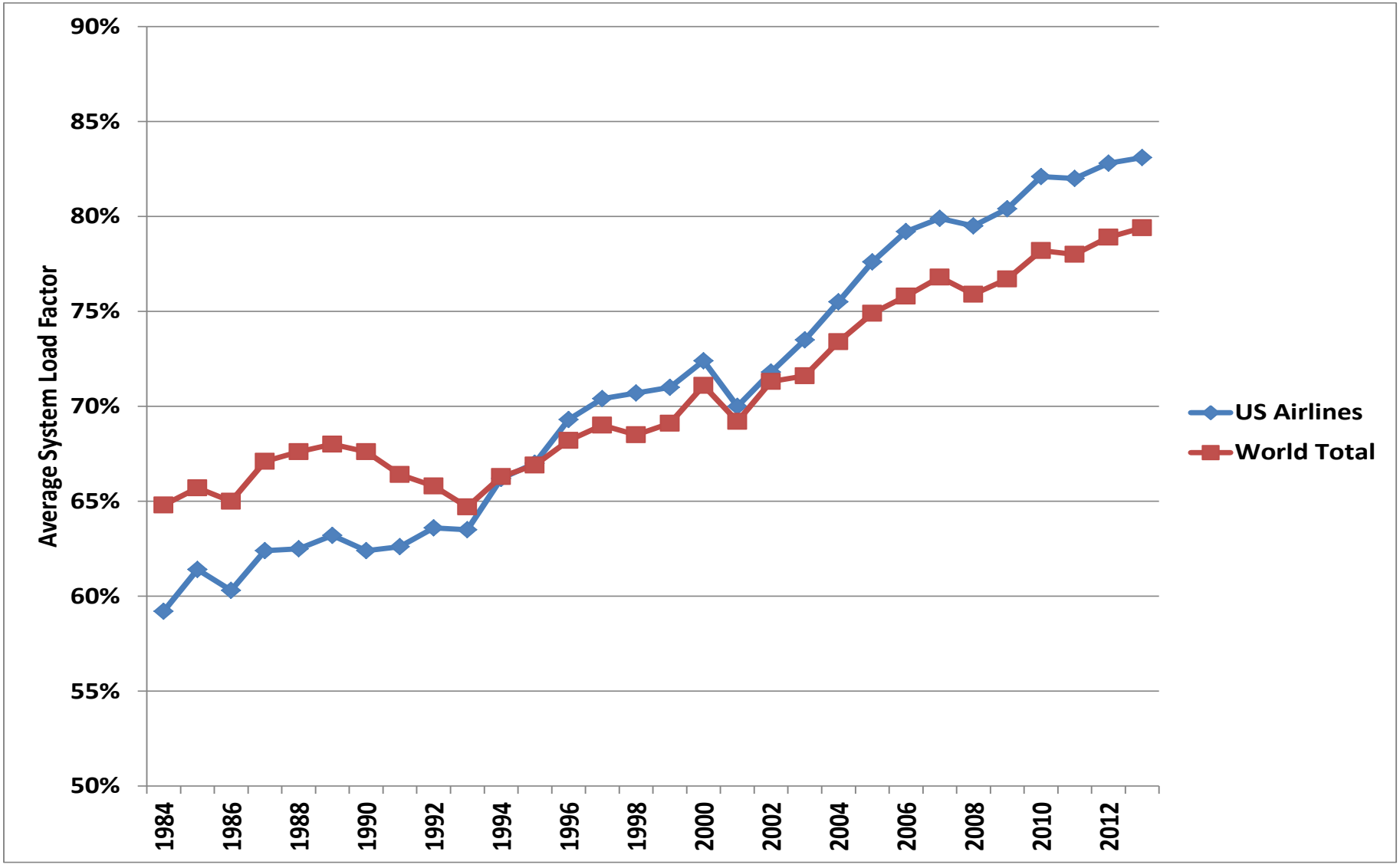
Airline Traffic (RPK) Growth 1984-2013



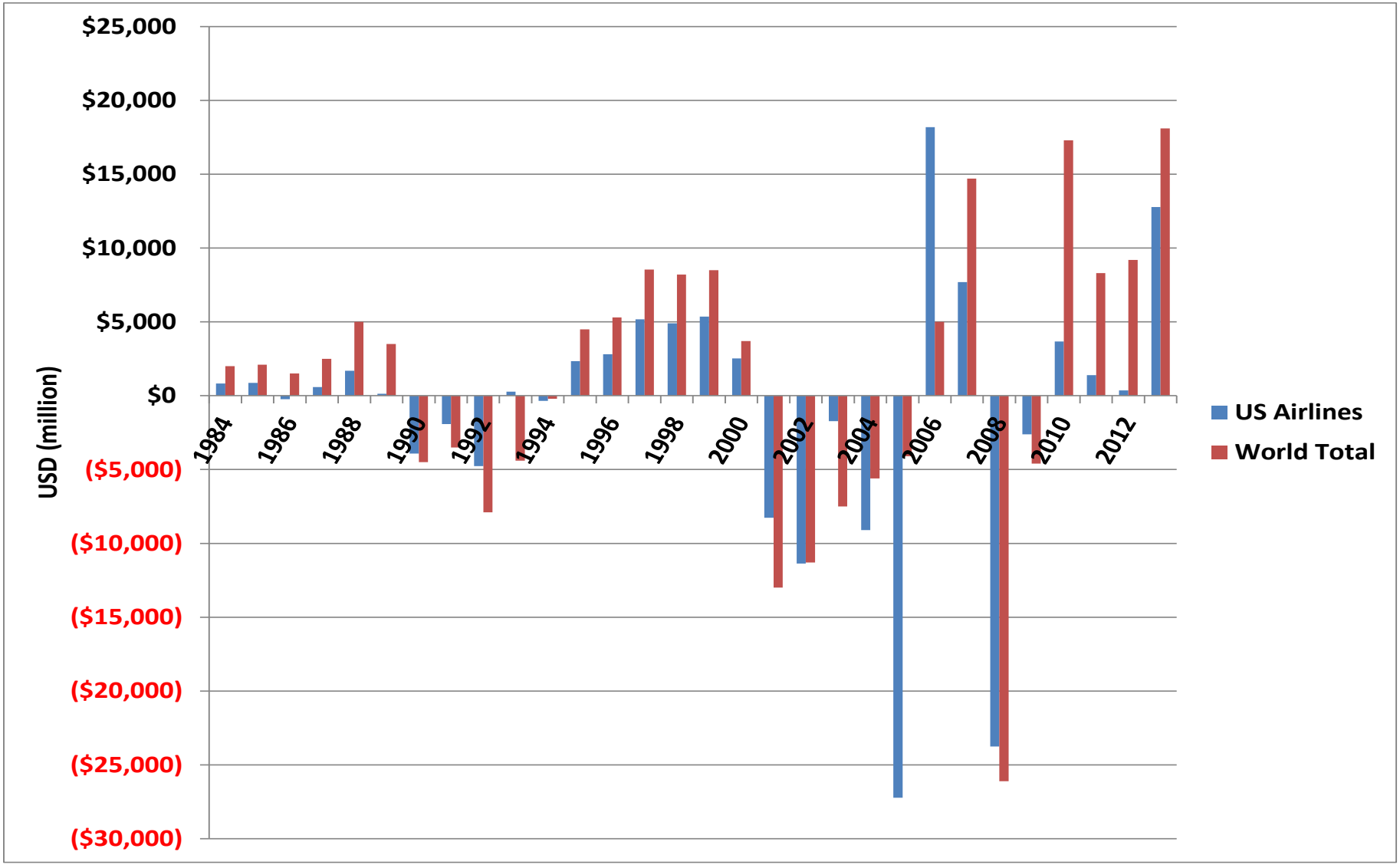
Annual % RPK Growth 1984-2013



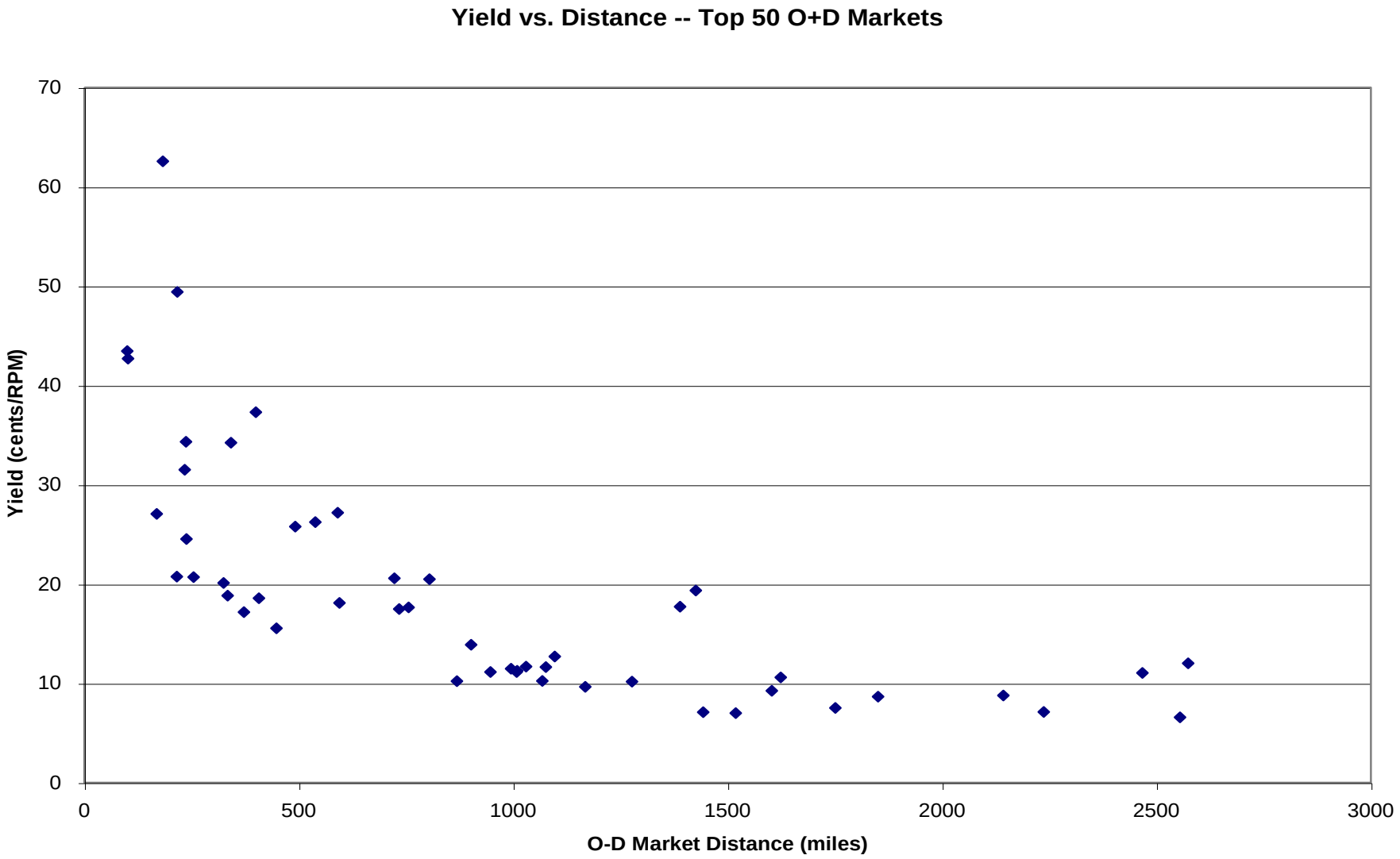
Average Load Factors 1984-2013



US and World Industry Net Profit 1984-2013



Yield vs. Distance Relationship



Additional Airline Measures

- **Average Stage Length**
  - Average non-stop flight distance
  - Aircraft Kilometers Flown / Aircraft Departures
  - Longer average stage lengths associated with lower yields and lower unit costs (in theory)
- **Average Passenger Trip Length**
  - Average distance flown from origin to destination
  - Revenue Passenger Kilometers (RPKs) / Passengers
  - Typically greater than average stage length, since some proportion of passengers will take more than one flight (connections)
- **Average Number of Seats per Flight Departure**
  - Available Seat Kilometers / Aircraft Kilometers Flown
  - Higher average seats per flight associated with lower unit costs (in theory)

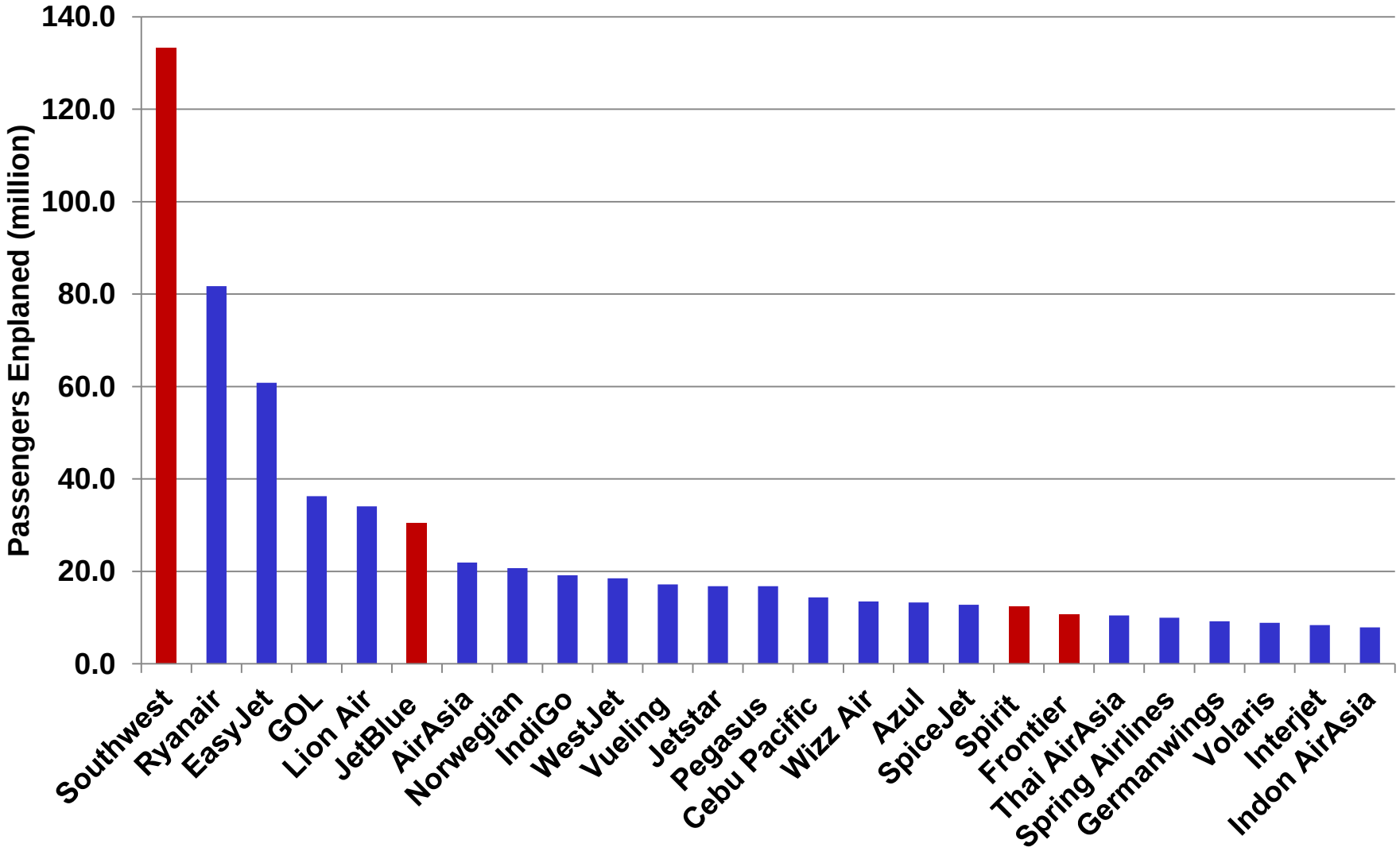
Competition Under Deregulation

- **The removal of economic regulations added several new dimensions to airline competitive strategies:**
  - Cost cutting and productivity improvement
  - Economies of scale in operations to reduce unit costs
  - Price competition and revenue management to increase revenues
  - New marketing and distribution programs
  - Increased network coverage and market dominance
- **Airline managers now actually have to make management decisions and trade-offs:**
  - In contrast to regulated times when government control ensured price increases to cover increased operating costs.

The LCC "Business Model"

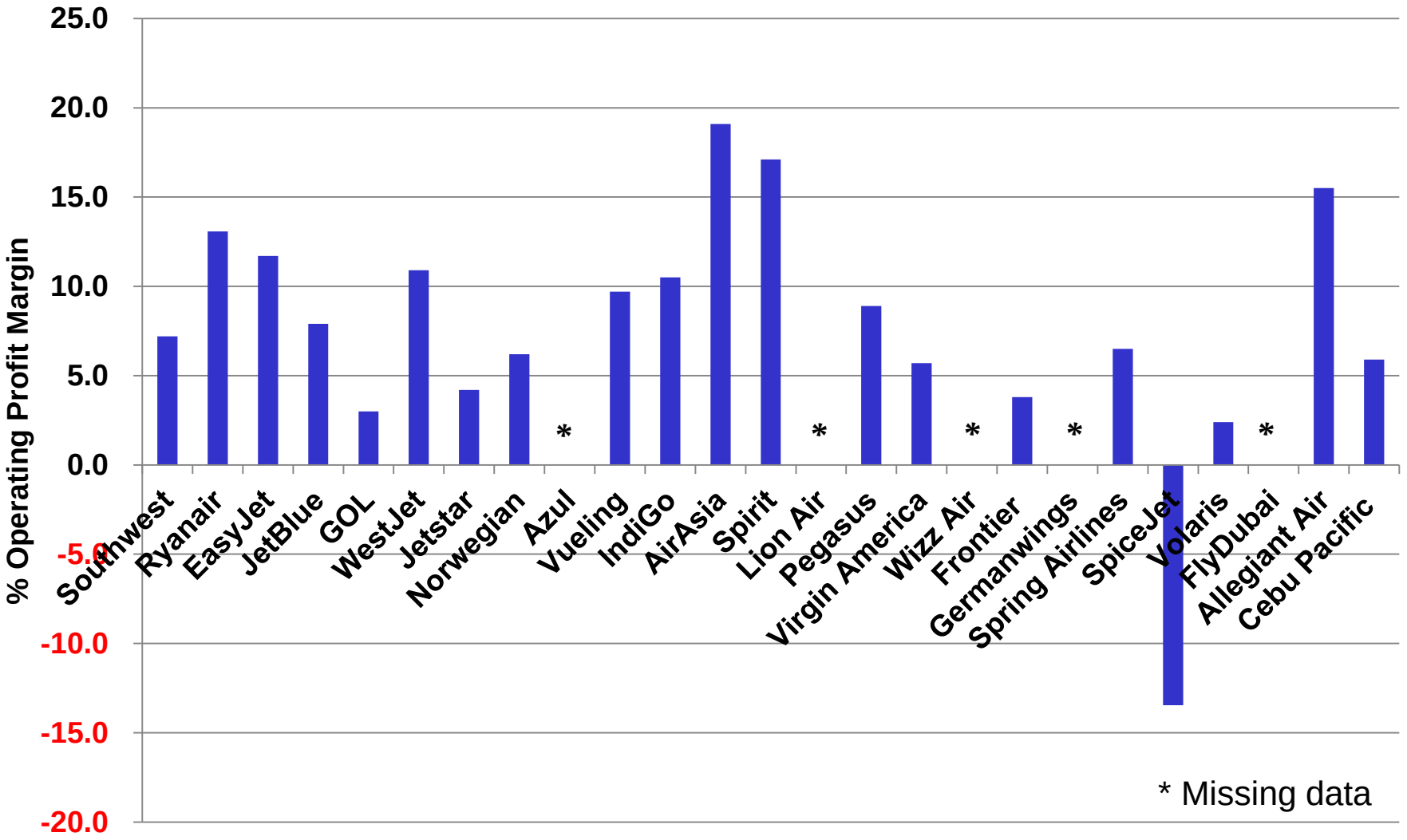
- **LCCs are assumed to use common strategies designed to reduce unit costs:**
  - Single aircraft type or family of aircraft
  - Point-to-point vs. hub network structure
  - No connecting tickets (only point-to-point) local passengers
  - No labor unions, low wage rates
  - Single cabin service, no "premium" classes on board
  - No seat assignment (in advance and/or at the airport)
  - Reduced "frills" and seating space on board
  - No frequent flyer loyalty programs
  - No distribution through Global Distribution Systems (GDS)
- **With LCC evolution, very few large LCCs actually fit this assumed LCC "business model" today…**

Top 25 LCCs by Passengers Enplaned



Source: Airline Business Top 50 LCCs 2013

Selected LCCs Operating Profit Margins

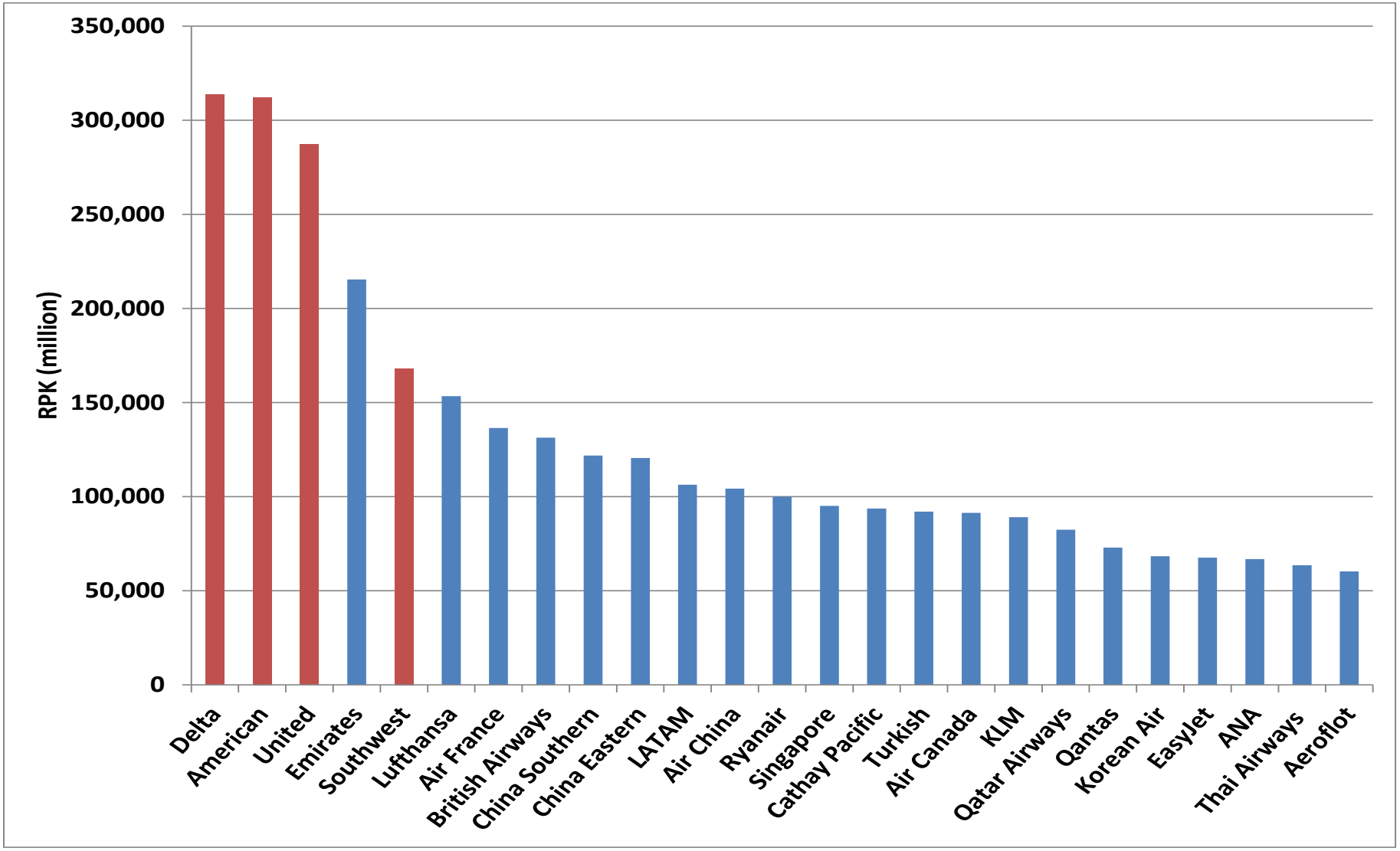


Source: Airline Business Top 50 LCCs 2013

The Global Airline Industry: A Tale of Three Sectors

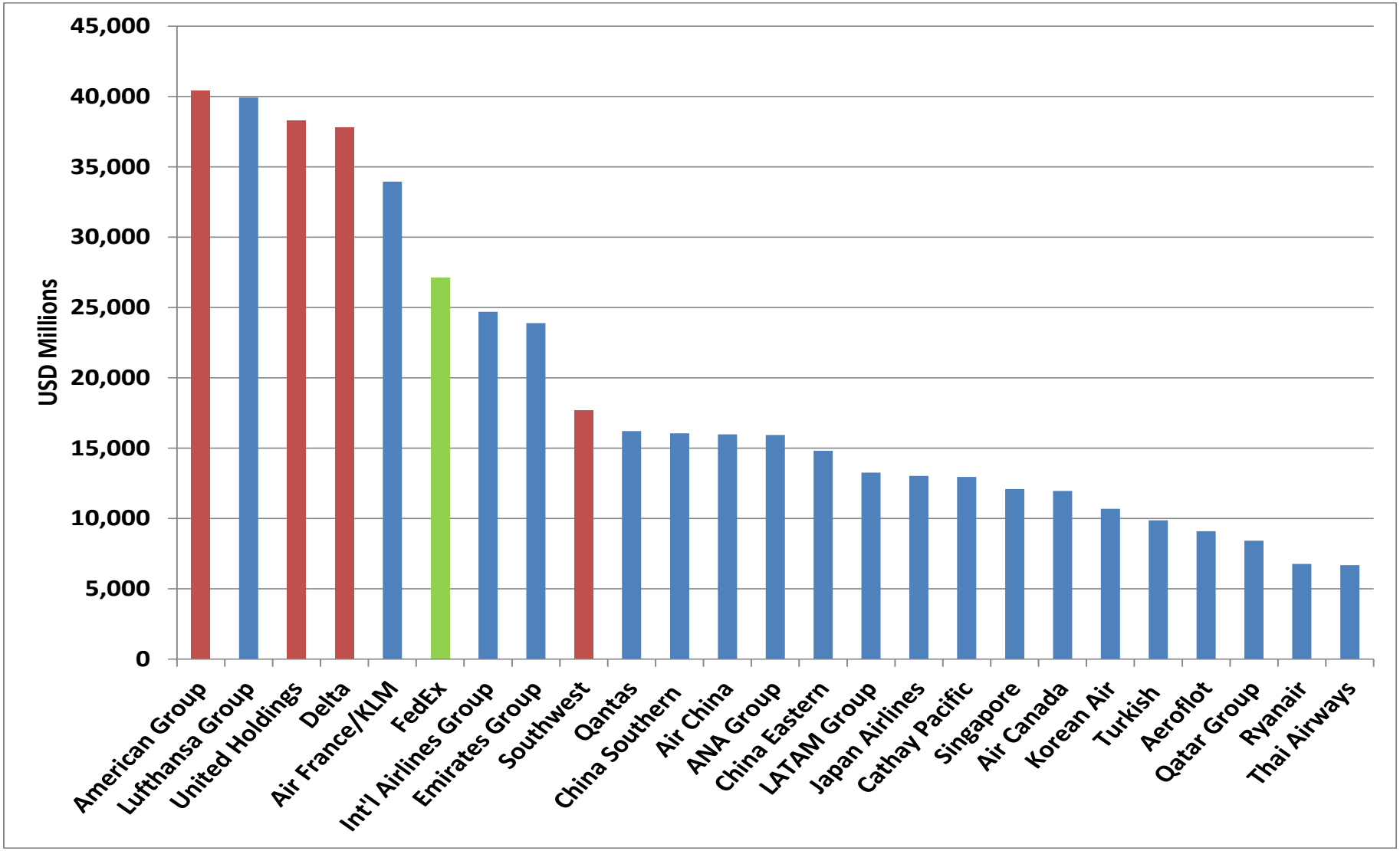
- **Network Legacy Carriers**
  - For some, bankruptcies and consolidation reduced excess capacity, allowed for labor cost and productivity improvements
  - But European legacy carriers still struggling with high costs
- **Low Cost Carriers**
  - LCC share of US domestic passengers has leveled off at 33%
  - LCCs continue to grow rapidly in other world regions
  - But unit cost advantages of new entrants tend to disappear as both aircraft and employees mature
- **Emerging Global Carriers**
  - Large hub networks based in Middle East, South America and Asia
  - Examples: Emirates, Etihad, Qatar, Turkish, Latam Group, China Southern, China Eastern

Top 25 World Airlines – Ranked by Passenger Traffic (RPK)



Source: Airline Business Top 200 Airlines Traffic 2013

Top 25 World Airline Groups – Total Operating Revenues



Source: Airline Business Top 150 Airlines Financial 2013

Emerging Global Carriers

- *Dubai, UAE*
- *232 Aircraft*
- *3rd largest airline by weekly ASK capacity*

- *Abu Dhabi, UAE*
- *109 Aircraft*
- *Owns large stakes in other airlines (e.g. Alitalia)*

- *Doha, Qatar*
- *149 Aircraft*
- *Joined oneworld alliance in 2014*

- *Istanbul, Turkey*
- *234 Aircraft*
- *Star Alliance member*

What do these growth projections imply for global airline rankings?

Rank	Airline	Country	RPK (2012)
1	Delta Air Lines	United States	310,466
2	United Airlines	United States	288,680
3	American Airlines	United States	203,299
4	Emirates Airline	United Arab Emirates	188,618
5	Southwest Airlines	United States	165,753
6	Lufthansa	Germany	149,780
7	Air France	France	135,824
8	British Airways	United Kingdom	126,436
9	China Eastern Airlines	China	109,113
10	China Southern Airlines	China	107,000
11	US Airways	United States	100,460
12	Ryanair	Ireland	100,000
13	Air China	China	95,940
14	Cathay Pacific	Hong Kong	94,191
15	Singapore Airlines	Singapore	93,766
16	Air Canada	Canada	89,534
17	KLM	Netherlands	86,281
18	Qantas	Australia	75,935
19	Turkish Airlines	Turkey	74,638
20	Qatar Airways	Qatar	73,608
30	Etihad Airways	United Arab Emirates	48,000

Rank	Airline	Assumed Annual Growth Rate	RPK (2020)
1	Emirates Airline	9.6%	392,781
2	Delta Air Lines	0.6%	325,989
3	United Airlines	0.6%	303,114
4	Southwest Airlines	5.0%	244,893
5	American Airlines	0.6%	213,464
6	China Eastern Airlines	8.0%	201,961
7	China Southern Airlines	8.0%	198,050
8	Turkish Airlines	11.5%	178,637
9	Air China	8.0%	177,578
10	Cathay Pacific	8.0%	174,341
11	Ryanair	7.0%	171,819
12	Qatar Airways	10.9%	168,981
13	Lufthansa	0.6%	157,269
14	Air France	0.6%	142,615
15	Singapore Airlines	5.0%	138,535
16	British Airways	0.6%	132,758
17	Etihad Airways	11.8%	117,240
18	US Airways	0.6%	105,483
19	Air Canada	0.6%	94,011
20	KLM Royal Dutch Airlines	0.6%	90,595
21	Qantas	2.0%	88,970

- **Growth rates for non-emerging carriers were extrapolated from recent growth patterns**

Source: Airline Business 2012 Rankings