

# Air Transport Liberalisation, Cost Reduction and Safety: Is there a Dangerous Trade-off?

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ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ  
ΤΜΗΜΑ ΔΙΟΙΚΗΣΗΣ ΕΠΙΧΕΙΡΗΣΕΩΝ

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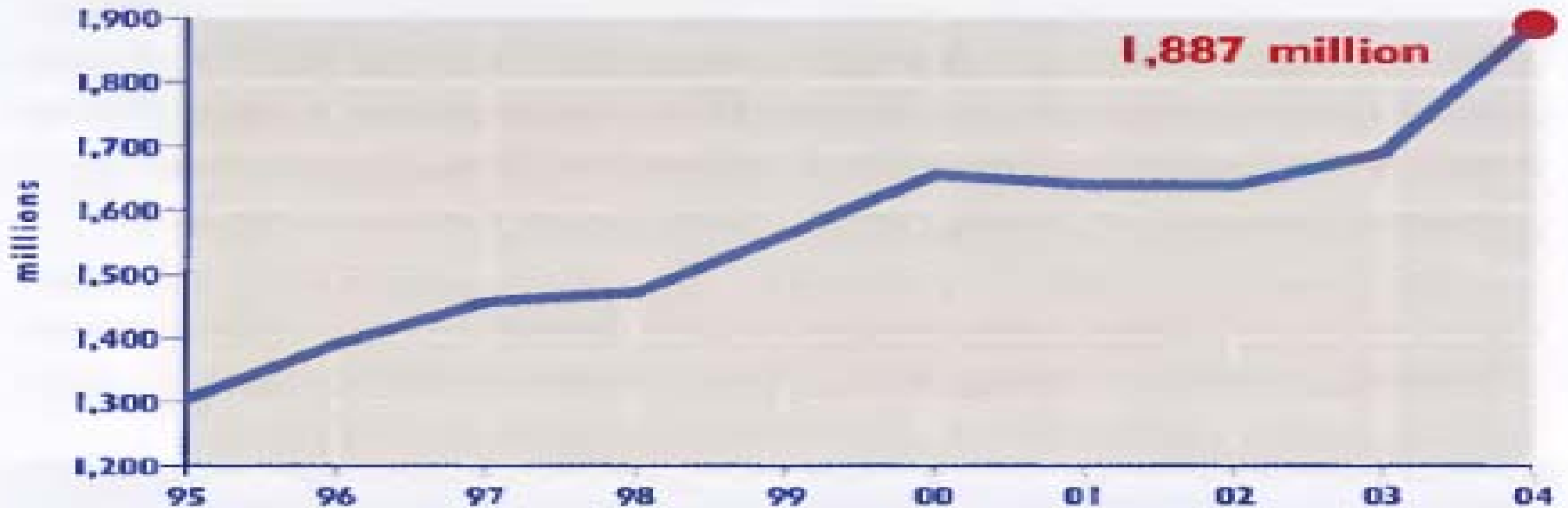
# Overview of the Presentation

- Inspiration and Statistics
- Review of the Literature
  - *key reference questions*
  - *empirical studies*
  - *the role of information*
- Contribution of the Paper
  - *formal mathematical model*
  - *econometric analysis*
- Conclusions based on ICAO Recommendations

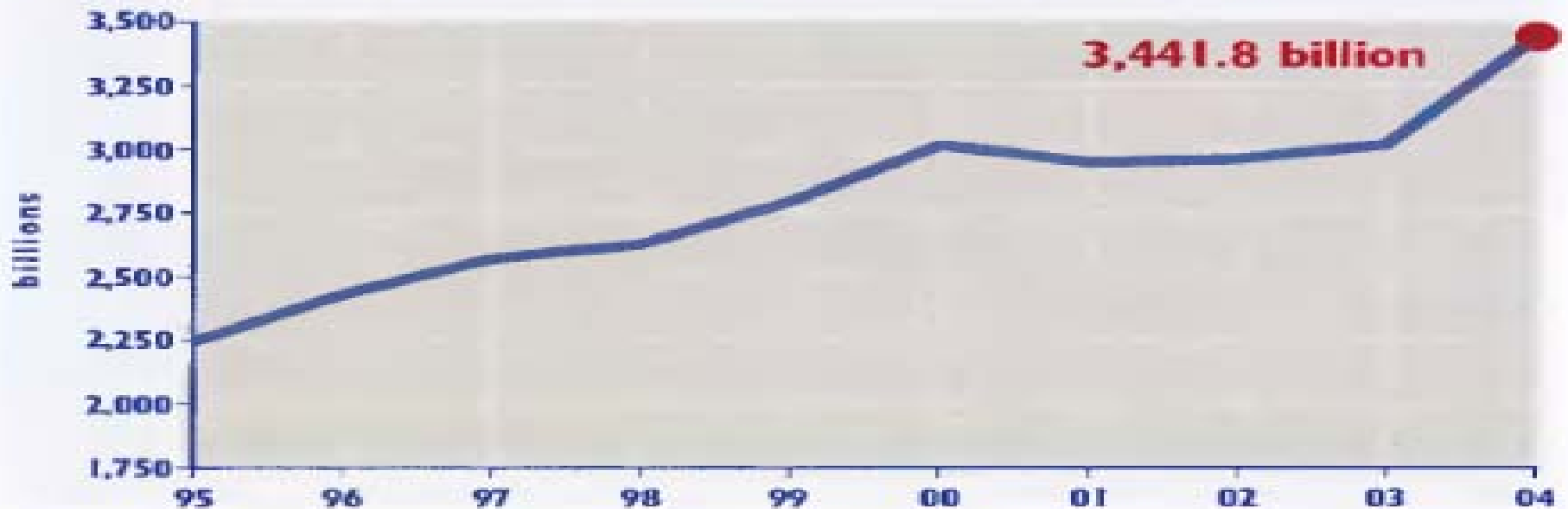


Photo: Iatrou

**Figure 1. Total passengers carried, 1995-2004**



**Figure 2. Total passenger-km performed, 1995-2004**



**Table 3-1. Accidents of aircraft with a certificated maximum take-off mass of more than 2 250 kg involving passenger fatalities on scheduled air services**

Year	Aircraft accidents	Passengers killed	Passenger fatalities per 100 million		Fatal accidents per 100 million		Fatal accidents per 100 000		
			Passenger-km	Passenger-miles	km flown	miles flown	aircraft hours	aircraft landings	
<b>Excluding the USSR up to 1992 and the Commonwealth of Independent States thereafter</b>									
1984	16	218	0.02	0.03	0.16	0.26	0.10	0.14	
1985	25	1 037	0.09	0.14	0.24	0.39	0.15	0.21	
1986	19	427	0.03	0.05	0.17	0.27	0.10	0.15	
1987	23	889	0.06	0.10	0.19	0.31	0.12	0.18	
1988	26	712	0.05	0.08	0.21	0.33	0.13	0.19	
1989	29	879	0.06	0.09	0.22	0.36	0.13	0.21	
1990	23	473	0.03	0.05	0.17	0.27	0.10	0.16	
1991	24	518	0.03	0.05	0.17	0.28	0.11	0.17	
1992	24	972	0.05	0.09	0.16	0.26	0.10	0.17	
1993	31	806	0.04	0.07	0.20	0.32	0.13	0.21	
1994	23	961	0.05	0.08	0.14	0.22	0.09	0.14	
1995	20	541	0.02	0.04	0.11	0.18	0.07	0.12	
1996	21	1 125	0.05	0.08	0.11	0.18	0.07	0.12	
1997	24	859	0.03	0.05	0.12	0.19	0.07	0.13	
1998	20	904	0.03	0.06	0.10	0.15	0.06	0.11	
1999	20	498	0.02	0.03	0.09	0.15	0.06	0.10	
2000	18	755	0.02	0.04	0.08	0.12	0.05	0.09	
2001	11	439	0.01	0.02	0.05	0.07	0.03	0.05	
2002	13	777	0.03	0.04	0.06	0.09	0.03	0.06	
2003	6	334	0.01	0.02	0.03	0.04	0.02	0.03	
<b>Including the USSR up to 1992 and the Commonwealth of Independent States thereafter</b>									
1986	24	641	0.04	0.07	na	na	na	na	
1987	25	900	0.06	0.09	na	na	na	na	
1988	29	742	0.04	0.07	na	na	na	na	
1989	29	879	0.05	0.08	na	na	na	na	
1990	27	544	0.03	0.05	na	na	na	na	
1991	29	638	0.03	0.06	na	na	na	na	
1992	28	1 070	0.06	0.09	na	na	na	na	
1993	33	864	0.04	0.07	0.20	0.32	0.12	0.21	
1994	27	1 170	0.05	0.09	0.15	0.25	0.10	0.16	
1995	25	711	0.03	0.05	0.13	0.21	0.08	0.14	
1996	24	1 146	0.05	0.07	0.12	0.19	0.08	0.13	
1997	25	921	0.04	0.06	0.12	0.19	0.07	0.13	
1998	20	904	0.03	0.05	0.09	0.15	0.06	0.10	
1999	21	499	0.02	0.03	0.09	0.15	0.06	0.10	
2000	18	757	0.03	0.04	0.07	0.12	0.05	0.08	
2001	13	577	0.02	0.03	0.05	0.08	0.03	0.06	
2002	14	791	0.03	0.04	0.06	0.09	0.04	0.07	
2003	6	334	0.01	0.02	0.02	0.04	0.02	0.03	

na not available

Source: ICAO accident/incident report programme (ADREP) and ICAO Air Transport Reporting Form A (Traffic).

# Key Reference Questions: Rose (1992)



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- Has airline safety declined since deregulation?
  - *statistics, maintenance and equipment failure*
  - *pilot error, increased congestion and ATC, staffing*
  
- Has airline deregulation reduced travellers safety?
  - *services in thin routes*
  - *network configuration and number of stopovers per trip*
  - *transport mode substitution*
  
- What accounts for differences in safety performance across carriers?
  - *financial impacts: reputation, liquidity constraints, near-bankruptcy, airline size and profitability-safety link*
  - *new entrants, experience and commuter carriers*
  
- What are the market penalties for airline accidents?
  - *legal issues, liability and negligence rules*
  - *aircraft and airline reputation, insurance premium, demand*



# Empirical Studies

- Borenstein and Zimmerman (1988) on market incentives for safe commercial airline operation
- Siomkos (2000) on airline disaster management and the role of consumer safety perceptions
- Raghavan and Rhoades (2005) on the relationship between profitability and air carrier safety in the US airline industry



# The Role of Information

- Adverse Selection and Missing Markets
  - *Akerlof's Lemons (1970)*
  - *implications for air transport safety*
  
- Principal – Agent Relationships (Sappington, 1991)
  - *principles of contract design*
  - *monitoring and competition, auctions and agency selection*
  - *dynamic interaction and the ratchet effect*
  
- The Economics of "192" (OXERA, 2003)
  - *variety of competing offers and search costs*
  
- Legal Liability and Negligence Rules (Cooter, 1991)
  - *the Hand Rule: a party is at fault if its cost of avoiding an accident is less than the resulting harm multiplied by its probability*



# Contribution of the Paper

- Formal Mathematical Model
  - *consumers choose discrete alternatives at the outer level combined with a continuous selection at the inner one (Papatheodorou, 2003)*
  - *safety records are observed but maintenance effort is not – carriers may face charges based on the Hand Rule*
  - *assess the impact of deregulation by looking at the elasticity of demand, the competitive conduct and the probability of condemnation*
  
- Empirical Analysis based on Primary Data
  - *questionnaire delivered to actual travellers*
  - *discrete choice analysis based on Likert scales and other characteristics*
  - *stated preference analysis to derive demand curves*



# Sketching the Model – Demand Side

Stochastic Utility:  $J_i = U(f_i, s_i) + \varepsilon_i$

Deterministic Utility:  $U(f_i, s_i) = \beta \cdot \ln f_i + (1 - \beta) \cdot \ln s_i$ ,  $0 < \beta < 1$

Choice Prob.:  $P_i = \frac{e^{\mu V_i}}{\sum_{n=1}^I e^{\mu V_n}}$

Budget Constraint:  $p_i \cdot f_i + q \cdot s_i = Y$

where  $\mathbf{J}$  denotes total utility and  $\mathbf{U}$  its systematic part,  $\mathbf{f}$  is the number of flights,  $\mathbf{s}$  is the level of air safety,  $\boldsymbol{\varepsilon}$  is the realisation of a random variable in an individual context,  $\boldsymbol{\beta}$  is a weighting parameter,  $\mathbf{P}$  is the choice probability,  $\mathbf{e}$  is exponent,  $\boldsymbol{\mu}$  is a dispersion parameter,  $\mathbf{V}$  is the indirect utility,  $\mathbf{p}$  is fare price,  $\mathbf{q}$  is safety premium,  $\mathbf{Y}$  is disposable income and  $\mathbf{i} = \mathbf{1}, \dots, \mathbf{I}$  stands for a specific carrier



# Sketching the Model – Supply Side

$$\text{Safety: } s_i = \theta \cdot m_i + A_i$$

$$\text{Reliability fn: } R(s) = \text{Pr} [S > s] = 1 - F(s)$$

$$\text{Cost: } C_i = C(f_i, m_i) = C_1(f_i) + C_2(m_i)$$

$$\text{Liability: } L_i = H \text{ if } C_2(m_i) < d(s_i) \cdot r \cdot H$$

$$L_i = 0 \text{ if } C_2(m_i) > d(s_i) \cdot r \cdot H$$

$$\text{Revenue: } R_i = p_i(\eta_i, \lambda) \cdot f_i + q \cdot s_i$$

$$\text{Profit: } \Pi_i = p_i(\eta_i, \lambda) \cdot f_i + q \cdot s_i - C_1(f_i) - C_2(m_i) - E(L)$$

to find:  $m_i^*$ ,  $\frac{\partial m}{\partial p_i}$ , etc.

where  $\theta$  is productivity,  $m$  is maintenance effort,  $A$  is a shock,  $R$  is survival fn and  $F$  is cum. distr. fn,  $C$  is cost,  $L$  is liability,  $d$  is the probability of having an accident,  $r$  is the probability of legal condemnation,  $H$  is the monetary value of accident,  $R$  is revenue,  $\eta$  is demand price elasticity,  $\lambda$  is competitive conduct,  $\Pi$  is profit and  $E$  is expected value



# Questionnaire - Filtering

- How many times have you travelled by plane during the past year?  
a. **None**\_\_\_\_ b. **1-5** Times\_\_\_\_ c. **5-10** Times\_\_\_\_ d. **Over 10** Times\_\_\_\_
- What is the primary reason for travelling today and in general?  
Leisure\_\_\_\_ Business\_\_\_\_
- How many times have you been delayed on a flight due to aircraft technical reasons?  
a. **None**\_\_\_\_ b. **1-5** Times\_\_\_\_ c. **5-10** Times\_\_\_\_ d. **Over 10** Times\_\_\_\_
- Do you often fly with the so-called 'full service' and/ or 'low-cost' airlines - why?
- What is your age group?  
a. 20-25\_\_\_\_ b. 26-35\_\_\_\_ c. 36-45\_\_\_\_ d. 46-55\_\_\_\_ e. 56-65\_\_\_\_ f. Over 65\_\_\_\_
- Please advise of your occupation  
a. Company Employee\_\_\_\_ b. Self-Employed\_\_\_\_ c. Student/Unemployed\_\_\_\_



# Questionnaire – Airline Choice

- Likert Scales 1-10 (1 not important – 10 very important)
- Reliability of arriving on time
- Convenience of departure time
- Duration of flight
- Cost of journey (including taxes)
- Feeling of safety
- Personal space at seat and comfort
- Provision of facilities (i.e. TV, music)
- Ability to work during flight
- Availability of free snacks and refreshments
- Proximity and accessibility of airport



# Questionnaire – Stated Preference

		<b>Airline A</b>		<b>Airline B</b>
On-time performance	%			
Total Cost	Euro			
Level of Service	1-3			
	Tick choice			

On-time performance due to technical errors of the fleet

Total cost (fare, airport taxes, on-board expenses)

Level of service offered by each carrier

Level 1: Very comfortable like own car, extended seat pitch and reclining seats, on-seat music, laptop sockets and complimentary drinks and/or meal.

Level 2: Adequately comfortable but no frills.

Level 3: Very basic product with no particular comforts or on-board services, low frequency

	Category 1	Category 2	Category 3	Category 4	Category 5	
COMPANIES	<b>View</b>	Compliance as Cost	Safety as Compliance	Safety as Risk	Safety as Opportunity	Safety is a Fully Integrated Business Practice
	<b>Issue</b>	Reducing costs	Sanctions (fines, jail, suspensions, etc.)	Waste	Customer/stakeholder interest	Sustainability
	<b>Driver</b>	Minimize compliance expenditures	Minimize sanctions	Minimize costs	Maximize revenues	Maximize profits
	<b>Process</b>	Comply when forced to and attribute blame	Internal inspections and audits supported by an internal system of rewards and punishments	Integrate safety programmes	Include safety issues in marketing and operational decisions	Fully integrate safety options and issues into all aspects of business
	<b>Approach to Safety Management</b>	Devoid of any approach to safety management	Compliance strategies	Safety Management Systems (SMS)	Safety Management Systems (SMS) + Business Strategies	Safety Management Systems (SMS) + Business Strategies + Business Modelling
	<b>Cultural Label</b>	Pathological	Reactive	Calculative	Proactive	Generative
REGULATORS	<b>Approach</b>	Surveillance Enforcement	Educating for compliance Assist in implementing self-audit programmes	Evaluate/assess management system	Monitor	Monitor
	<b>Philosophy</b>	Prescribe Enforce	Companies demonstrate compliance	Companies demonstrate safety performance	Self-regulating	Private regulation
	<b>Resource Distribution</b>	Regulator resources				Company resources



# Thank you very much!

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