

An Analysis of Profit Cycles in the Airline Industry

Helen Jiang¹ and R. John Hansman²

Massachusetts Institute of Technology, Cambridge, MA, 02139

[Abstract] This paper discusses the financial dynamics of the airline industry by identifying the fundamental cycle periods of profitability and their driving factors. Assuming the industry profit cycles could be modeled as an undamped second-order system, the fundamental cycle period was found to be 11.3 years for the U.S. airline industry and 10.5 years for the world airline industry. An empirical profitability model was estimated and the results revealed that such cycle period is endogenous, neither deregulation nor September 11 have significantly changed the cycle length. To analyze the causes of profit cyclicity, parametric models were developed under the hypothesis that phase lag in the system caused the profit oscillations; and two hypotheses, lag in capacity response and lag in cost adjustment were studied. Analysis of the parametric model of capacity response indicated that the system stability depends on the delay between aircraft orders and deliveries and on the aggressiveness in airplane ordering. Exaggerated capacity response was observed in the simulation as the gain in the model has lumped impacts of exogenous factors, suggesting capacity shortfall alone cannot fully explain the industry dynamics. The model also indicates reducing delay may help to mitigate system oscillations. Simulation results of the parametric model regarding cost adjustment were consistent with profit observations. Finally, a coupled model was developed to study the joint effects of capacity and cost. Simulation results indicated that the coupled model explained industry dynamics better than individual capacity or cost models, suggesting that the system behavior is driven by the joint effects of capacity response and cost adjustment.

Nomenclature

T	=	fundamental cycle period of the profitability of the airline industry
τ	=	e-folding time indicating how rapidly the amplitude grows
t	=	time
t_0	=	time instant the system crosses zero
A	=	amplitude of profit oscillation
$x(t)$	=	industry profit or loss in billions of constant 2000 dollars
C_0	=	intercept
K	=	control gain in the capacity/cost parametric model
D	=	delay in the capacity/cost parametric model
ω_{crit}	=	critical frequency at which the system oscillates with constant amplitude
T_{crit}	=	critical cycle period corresponding to ω_{crit}
K_{crit}	=	critical gain corresponding to ω_{crit}

I. Introduction

THE air transportation in the United States has experienced rapid development through boom-and-bust cycles, particularly since deregulation in 1978. Prior to 1978, the airline industry resembled a public utility; the routes each airline flew and the fares they charged were regulated by the Civil Aeronautics Board (CAB)¹. As the Airline Deregulation Act eliminated CAB's authority over routes and domestic fares, the airline industry transformed into a market-oriented sector, driven by the dynamics between demand and supply.

¹Research Assistant, International Center for Air Transportation, Room 17-010, MIT, 77 Massachusetts Avenue, MA 02139, AIAA member.

²Professor and Director of International Center for Air Transportation, Department of Aeronautics and Astronautics, Room 33-303, MIT, 77 Massachusetts Avenue, MA 02139, AIAA fellow.