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New evidences on airline efficiency and yields: a comparative analysis of major North American air carriers and its implications

Tae Hoon Oum, Xiaowen Fu, Chunyan Yu*

Sauder School of Business, The University of British Columbia, Vancouver, BC, Canada V6T 1Z2

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Abstract

This paper measures and compares the performance of 10 major North American airlines in terms of residual total factor productivity, cost competitiveness, and residual average yields during the period 1990–2001. Our key findings are: (a) the airlines in North American improved productive efficiency by about 12% between 1990 and 2001 despite the fact that there were substantial reduction of residual TFP between 2000 and 2001; (b) airlines need to perform well in both productive efficiency and pricing to be financially successful; (c) significant productivity improvement in the 1990s enabled the airlines to cope with rising input prices and downward pressure on yields; (d) airlines that aggressively expanded fleet in response to the fast growing market during the mid-1990s have suffered loss in productive efficiency; (e) the 9/11 terrorist attack has led to substantial reductions in airlines' yields, and declining productivity and increasing unit cost.

Keywords: Airlines; Productive efficiency; TFP; Cost competitiveness; Yields

1. Introduction

Significant changes have occurred in the North American aviation market during the 1990s and early 2000s: the growth of low cost carriers, the open skies agreement between Canada and US, the formation of global alliance networks such as Star Alliance, One-World, Sky Team, and Wings, mergers between major airlines such as American (AA) and TWA, Air Canada (AC) and Canadian Airlines International (CAI), an unprecedented decline in demand for air travel caused by collapse of the high tech bubble and the 9/11 terrorist attacks, etc. These events have affected productivities, unit costs, average yields, and consequently financial situations of airlines. It is timely, therefore, to re-evaluate relative performance of the airlines in these aspects, and study key reasons behind the changes in relative ranking of airlines. This paper intends to accomplish these objectives by measuring and comparing the productive efficiency, unit cost competitiveness, and average yields of 10 major full service carriers in Canada and the US for the period of 1990–2001.

Section 2 reviews previous studies on airline cost and efficiency. Section 3 presents key characteristics of the sample airlines, followed by a description of the input and output variables used in the study. In Section 4, we compute the gross total factor productivity (TFP) of the airlines, identify sources of the observed TFP differentials, and compare the residual TFP levels, the indicator for productive efficiency. The unit cost competitiveness of the airlines are computed and presented in Section 6. Section 7 compares average yields across airlines and over time as well as attempts to explain the profitability differentials in relation to the measured productivity, cost competitiveness and average yields. Summary and concluding remarks are given in the last section.

2. Previous research

There is a large body of literature on measuring and comparing airline productivity performance. Caves et al. (1981b) compared 11 US trunk airlines on the basis of

* Corresponding author. Tel.: +1 604 822 9416; fax: +1 604 822 0635.
E-mail address: chunyan.yu@sauder.ubc.ca (C. Yu).

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levels and growth rates of outputs, inputs, and TFP for the 1972–1977 period. Caves et al. (1987) compared the TFP performance of a sample of US and non-US airlines over the 1970–1983 period. Gillen et al. (1985, 1990) measured and compared the productive performance of seven Canadian air carriers for the 1964–1981 period by measuring TFP and estimating total and variable cost functions. Encaoua (1991) examined cost and productivity differences among European carriers, and found that the gap in productivity measures between the carriers shrunk over time during the 1981–1986 period. Windle and Dresner (1992) investigated the relationship between typical industry measures of productivity and TFP using a data set of US and non-US airlines for the 1970–1983 period.

Good et al. (1995) examined the performance of the eight largest European and the eight largest American air carriers for the period of 1976–1986 using both stochastic frontier method and the data envelopment analysis (DEA) method. Ehrlich et al. (1994) examined the effects of state versus private ownership on rates of firm-specific productivity growth and cost decline, based on a panel data of 23 international airlines during the period of 1973–1983. Oum and Yu (1995, 1998a,b) measured and compared productivity and cost competitiveness of the world's 23 major airlines for the 1986–1993 period. Alamdari and Morrell (1997) analyzed trends in unit labor costs of major US and European carriers over the 1978–1985 period. Forsyth (2001) conducted a TFP analysis to examine productivity performance of the airlines in Australia in the 1980 and 1990s.

With the exception of Forsyth (2001), none of the aforementioned studies have examined how airlines performed in 1990s and early 2000s. Furthermore, most of the studies focused on measuring productive efficiency only. Few examined unit cost competitiveness or average yields. Although productive efficiency is an important issue, cost competitiveness and ability to generate revenues are perhaps more important for an airline's financial survival and success. This paper uses a relatively recent data to measure and compare the productive efficiency, unit cost competitiveness, and average yields of 10 major full service network carriers in the US and Canada. In addition, we attempt to explain the financial performance of these carriers using results on productivity, cost and yield.

3. Sample airlines and output and input variables

Our data covers ten major air carriers in the US and Canada for the 1990–2001 period: Alaska, America West, American, Continental, Delta, Northwest, United, US Airways, Air Canada and Canadian Airlines International (CAI merged into AC in 2000). The data were compiled from various sources including International Civil Aviation Organization (ICAO),[1] Avmark, Inc., OECD, International Monetary Fund (IMF), Statistical Abstract of the US, as well as airlines' annual reports. The key characteristics of the sample airlines are listed in Table 1.

With the exception of CAI, all airlines in our sample expanded their operation considerably during the study period. The revenue growth rates range from 50% for US Airways and Northwest to 96% for Alaska. Such remarkable growth is a reflection of the economic growth in the US during the 1990s. All of our sample airlines also experienced significant increase in their average stage length of flights as they expanded their network to increase long haul and international routes.

Productivity measurement requires detailed data on outputs, inputs, network and operational attributes. Following a similar framework as was done in Oum and Yu (1995, 1998a,b), we considered five output variables and five input variables. The five output variables are: scheduled passenger service (measured in Revenue-Tonne-Kilometres or RTK), scheduled freight service (measured in RTK), mail service (measured in RTK), non-scheduled passenger and freight services (measured in RTK), and incidental services output. Incidental services refer to a carrier's non-airline businesses including catering services, ground handling, aircraft maintenance and reservation services for other airlines, sales of technology, consulting services, hotel business, etc. In order to include the incidental services in the analysis, a quantity index of incidental services output is constructed by deflating the incidental revenues with the US GDP deflator adjusted by purchasing power parity (PPP).

The input variables are labor, fuel, materials, flight equipment, and ground property and equipment (GPE). Labor input is measured by number of full time equivalent employees. It should be noted that most of the airlines downsized their work force substantially in the fourth quarter of 2001 following the 9/11 incidence. This may have affected accuracy of the value of 2001 labor input.[2] For flight equipment, a fleet quantity index is constructed by aggregating 14 types of aircraft using the translog multilateral index procedure proposed by Caves et al. (1982).[3] Aircraft leasing rates are used to approximate aircraft service prices in the aggregation. The real stock of GPE is estimated using the perpetual inventory method. Under the assumption of the flow of capital service is proportional to the capital stock, the annual cost of using GPE is computed by multiplying the real GPE stock with a GPE service price. This GPE service price is constructed using the method proposed by Christensen and Jorgenson (1969). Since the GPE costs are small relative to the costs of flight

[1] Digest of statistics series: *financial data*, *traffic*, and *fleet and personnel*.

[2] Some of the one-time labor related costs may have been reported as general and administration costs, and thus, included in the material costs category instead of labor cost.

[3] See, for example, Oum and Yu (1998b) for an example of this multilateral index computational procedure applied to a panel data.