Chapter 1
Introduction to Efficiency and Competitiveness of International Airlines

Abstract This chapter provides the background on the significance of an efficiency analysis of airline industry in terms of its performance, motivation, and main objectives. This introductory chapter reviews the market size and economic contributions of the aviation industry to the global economy and briefly discusses the key issues in the industry in recent decades. It also provides an outline of the research questions, methodologies used, and the structure of the chapters in this volume.

Keywords Stochastic frontier functions · Cost efficiency · Production efficiency · Panel data · Airlines

1.1 Overview of the Airline Industry

Aviation is one of the major global industries, creating more than 8.7 million jobs within the industry and contributing to 2.4 trillion USD in revenues, which is around 3.4 % of the global GDP,[1] to the world economy. Since its first operation with passenger and mail services in 1903, the airline industry has undergone wide-ranging changes, keeping with the fast development of technology and the evolution of the world economy. Despite the industry's technological, economic, managerial, and social impacts, it has become a major challenge from an environmental perspective. Table 1.1 shows the recent developments in the industry in terms of various standard performance indicators. These include revenues, expenses, operating profit, net profit, profit margin, and returns on investment for the period 2004–2015.

---

[1]IATA (2014b), "Aviation benefits beyond borders" page 2–8.

Table 1.1 Airline industry's financial statistics, 2004–2015. (*Unit* USD billion)

Category	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015F[b]
Revenue	379	413	465	510	570	476	564	642	706	717	733	727
Expenses	376	409	450	490	571	474	536	623	687	692	699	677
Operating profit	3.3	4.4	15.0	19.9	−1.1	1.9	27.6	19.8	18.4	25.3	33.9	50.1
Net profit	−5.6	−4.1	5.0	14.7	−26.1	−4.6	17.3	8.3	6.1	10.6	16.4	29.3
% margin	−1.5	−1.0	1.1	2.9	−4.6	−1.0	3.1	1.3	0.9	1.5	2.2	4.0
ROI[a] capital (%)	2.9	3.0	4.6	5.5	1.4	2.0	6.3	4.7	4.3	4.9	5.7	7.5

[a]Return of invested
[b]Forecasted
Source IATA (2014a) fact sheet
Note The statistics is for worldwide commercial airlines

According to the World Bank's estimates, the services sector GDP—which includes value added in wholesale and retail trade (including hotels and restaurants); transport; and government, financial, professional, and personal services such as education, health care, and real estate services[2]—accounted for 63.3 % of the world GDP in 2013, with air transportation revenue alone contributing to 1.49 % of the world's service sector GDP.[3] If we compare the economic contribution of aviation with that of other industries, the global air transport sector is bigger than pharmaceuticals ($451 billion), textiles ($223 billion), and automotive industries ($555 billion), and it is roughly half as big as the global chemical ($1282 billion) and food and beverage ($984 billion) sectors (IATA 2014b). In other words, "if air transport were a country, its GDP would rank as 21st in the world, roughly equal to that of Switzerland and more than twice as large as that of Chile or Singapore" (IATA 2014b). Table 1.2 provides some basic statistics on the air transportation industry, including the number of airlines, airports, and aircrafts; employment; and handling volume.

According to the studies conducted by the International Air Transport Association (IATA 2011) on air travel trends over the last 40 years, the volume of air travel worldwide, measured with aggregated revenue passenger kilometers (RPKs), has expanded more than tenfold and the total cargo volume has grown 14-fold (IATA 2011) despite repeated disruptions, including recessions and various global problems such as epidemics (e.g., AIDS, SARS, Avian Flu, Ebola Virus, and MERS), environmental degradation, natural catastrophes, and terrorism (Pearce 2012).

[2]The aggregate world GDP in 2013 was 74,909,811 million US dollar, of which agriculture accounted for 6 %, industry 30.7 %, and services 63.3 %. http://www.indexmundi.com/world/economy_profile.html.
[3]This estimate is based on the airlines' revenue and the world GDP of 2013, based on IATA (2013a, b).

Table 1.2 Air transportation industry statistics

Airlines[a]	1397 commercial airlines	49,871 routes
Airports/aircrafts[a]	3864 airports	25,332[b] aircrafts
Employment[c]	Direct 8.7 million jobs	58.1 million[d]
Handling volume[b]	Passenger: 2.97 (billion)	Cargo: 51.7 tone (millions)

[a]Base year is 2014
[b]Commercial services, 20,101 jets and 5231 turboprops
[c]Based on 2012
[d]Job supported by aviation worldwide
Source IATA (2014b) and industry statistics and IATA (2012, 2013a, b) annual report of 2012 and 2013

Airline passenger, goods, and postal services have become an intrinsic part of the modern and globalized economy. Statistics show that there is a strong interdependence between the airline industry and the world economy; for instance, the movement of cargo volume is consistent with the fluctuations in international trade.[4] The economy provides resources such as labor, education and skill, capital and energy to airlines, while airlines in turn provide services and generate jobs[5] and revenues by deploying these productive resources. More fundamentally, by transporting people and goods to locations where they are needed the most, air transportation lubricates the wheels of the world economy. As part of the two-way causal relationship, economic growth fuels the demand for airline travel, as is evident in the People's Republic of China (PRC), India, and several other emerging economies.

While the relationship between airlines' performance and the broader economy is inherently complex, it is one of mutual dependence, with each strengthening the other. Looking at the latest performance of airlines, the accumulated worldwide scheduled revenue ton kilometer (RTK) was 5.4 trillion kilometers in 2014[6] (IATA 2014b). Around 52 % of international tourists traveled by air. Approximately 35 % value of world trade was carried by air, accounting for only 0.5 % of the volume of world trade (IATA 2014b). Airlines collectively earned a total net profit of $16.4 billion in 2014 or a 2.2 % margin on revenues.

As is the case in other industries, airlines' economic performance is considerably influenced by the world's economic growth. Nevertheless, the airline industry has risen at a much faster pace than economic growth in other sectors. IATA (2011) reported that in the last 40 years, air transportation grew more than three times as fast as the world economy. Furthermore, while the airline industry suffered a slump during the global financial and economic crisis of 2008–2009, its recovery has been

---

[4]According to IATA (2014a), "Air transport is vital for world trade today, which is mostly in components rather than finished goods. IATA estimates that the value of international trade shipped by air in 2014 reached $6.4 trillion value of cargo handled by air in 2012. Tourist, people travelling by air on the other hand spent an estimated $621 billion" (IATA 2014a).

[5]In 2014, airlines created 2.39 million jobs directly and 58.1 million jobs indirectly in form of supply chain jobs (IATA 2014a).
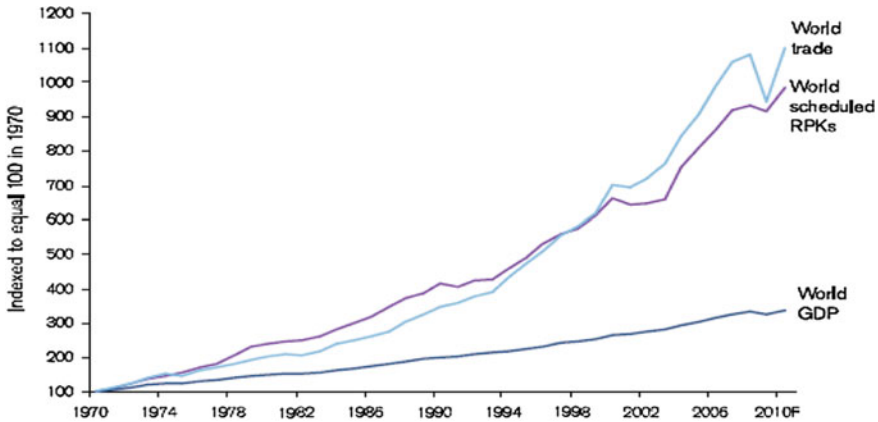
[6]In 2013, it was 5.7 trillion.

Fig. 1.1 Development of the world GDP, trade and aviation service, 1970–2010. *Source* IATA (2011)

noticeably faster and more robust than most other industries and activities. Figure 1.1 shows that world trade and world scheduled RPKs have developed much faster compared with 1970 used as the base year. Furthermore, it shows that the world scheduled RPKs recovered from the global economic crisis of 2008 much faster that world trade and GDP.

Airlines have made a huge contribution to the economy by creating jobs, business opportunities,[7] and revenues. Moreover, they have benefitted consumers by providing convenient travel, fast transportation , and fresh products delivered by air transportation.[8] Analyzing the various factors that influence the airline industry's competitiveness thus becomes a noteworthy exercise. The policy implications that emerge from our analysis will be relevant for not only the airline industry but also the broader globalized and national economies.

1.2   Background to Airlines' Competitiveness

The issues related to competitiveness of firms, industries, and even entire economies or countries have been a common subject of interest among academics, policy-makers, and the general public. In particular, in light of the rapid advent of the recent wave of globalization, which has eroded barriers between countries and catalyzed cross-border economic transactions, we find it meaningful to examine the

---

[7]Supply chains such as catering, airport services and sometimes hotel services.

[8]"Air transport plays an especially pivotal role in just-in-time global manufacturing production and in spreading fresh products from agricultural communities in developing economies to markets in the industrialized world" (IATA 2014b).

international competitiveness of the airline industry. This is because the industry is a principal actor in the globalization process as well as one of its main facilitators.

There are a number of reasons we chose the airline industry as the subject of our competitiveness analysis. First, virtually all countries operate at least one airline, which often serves as a national symbol and facilitates international business and trade development, allowing for a comparison of the competitiveness of airline industries at the international level.

Second, at first sight, the airline industry performs the simple function of transporting people and goods between different locations. However, a closer examination reveals a constellation of factors—aviation agreements, a wide range of constraints, and the economic situation of countries—that make airlines a highly complex industry. In addition, the highly competitive and technologically sophisticated nature of the airline industry means that it has many ramifications for the national competitiveness strategies.

Airline competitiveness analysis has a special resonance in Korea, which has a rapidly expanding airline industry and economy. Furthermore, Incheon airport located outside the capital city of Seoul has emerged as a major air travel hub in East Asia, and air transportation has become a key tool in Korea's dynamic export sector. Since airlines' performance is closely related with the upturn of the economic cycle, GDP and world trade growth, an analysis of airlines' competitiveness can enable an understanding of the underlying components of the services sector's competitiveness.

Lastly, while Asia, especially East Asia, now possesses a well-developed, export-oriented, and globally competitive manufacturing sector, its services sector still lags far behind the advanced economic systems as well as the optimal service sector level and organization capacity. As such, a competitiveness analysis of the airline industry, one of the most important service industries, can help Asian policymakers to better prepare for the liberalization of the services sector, which is expected to gain momentum in the near future.

Globalization, defined as the free movement of goods, people, and capital, breaks down national borders and dilutes the distinction between local and global markets. This phenomenon can be an opportunity and also a challenge for the airlines. The rapid growth of international trade and travel, facilitated by growing liberalization of trade (e.g., GATT, WTO) and travel (e.g., easing of visa requirements and agreements of terms of trade) is fueling the growth of both passenger and cargo traffics. At the same time, the growth of air transport capacity is a major impetus behind and a facilitator of the growth of international trade and travel.

Like globalization, technological progress in communication and other business sectors can create both opportunities and challenges for the airline business. In an environment of intense globalization and fierce competition among corporations for market shares and survival, the performance outcome of airlines can differ greatly depending on their business strategic choices as well as the global, regional, and national economic development and conditions. As a consequence, the airline industry is a highly competitive industry, constantly buffeted by structural changes and continuously adapting to changes in its fluctuating environment. This is

self-evident and reflected in the airlines' continuous entry into and exit from local and global markets (see Appendix 1.1). In such a dynamic environment with intense competition, it is challenging for firms to achieve and sustain growth.

Mere survival is a major achievement in an industry characterized by constant bankruptcies, mergers and acquisitions of existing firms, birth of new firms, and formation of alliances. More generally, achieving a certain market size is a prerequisite for success in a highly dynamic industry characterized by continuous and extensive structural changes. Therefore, gaining a larger market share based on cost competitiveness and product competitiveness is the primary rather ultimate goal of airlines to withstand global competition.

In addition to the airlines' overall business strategies, the market structures of the countries where the airlines are based significantly shape their national, regional, and global competitiveness. The relationship between airlines and their respective home country's market conditions is interdependent, much like the relationship between airlines and the economy as a whole. Airlines are considered a precondition for the economic development of many nations and their specific industries.

1.3   The Conceptual Framework

The key objective of strategic management studies has been to understand how some firms can perform better than others under fierce competition. Many researchers have tried to explain the phenomenon. Achieving a sustainable competitiveness in a global market has been crucial concerns for the airline industry.

In our analysis of airlines' competitiveness, the theoretical framework used will be Michael Porter's competitive advantage. Porter was the first to formulate a concept of competitive advantage as the determinant factor for firms' performance in global competition. According to him, competitive advantage results from the competitive strategies that firms choose and implement in their business practices. These choices of strategy make firms profitable and sustainable in the competition within the industry (Porter 1986). Porter argued that, "to achieve competitive success, firms must process a competitive advantage in the form of either lower costs or differentiated products that command premium prices." "To sustain advantage, firms must achieve a competitive advantage over time, through providing higher quality products and services or producing more efficiently" (Porter 1990, pp. 10). "Competitive advantages statements help distinguish companies by highlighting what they offer to the customer using tangible terms and concepts" (Porter 1990).

Along with the concept of competitive advantage, we need to build a logical/systematic framework to form the backbone of this empirical study. We now provide the basic definitions and concepts that will be used in this study, especially when selecting variables for the empirical performance analysis.

Performance of the airlines is estimated in terms of efficiency of the services provided by the airlines as units of production. Several researchers who have

developed the concept of efficiency have expressed their views about the frame-work and its importance for business operation and competitiveness. "The quest for identifying changes in efficiency is conceptually different from identifying technical change" (Diewert and Lawrence 1999). "Full efficiency in an engineering sense means that a production process has achieved the maximum amount of output that is physically achievable with current technology, and given a fixed amount of inputs used in production of goods or services" (Diewert and Lawrence 1999).

Economic efficiency is a product of technical and allocative efficiencies. Kumbhakar and Lovell (2000) Heshmati (2003) and Kumbhakaret al. (2015) pro-vide a complete overview of the methodology and its applications to cross-section and panel data cases under different objectives, distributional assumptions, and estimation methods, as well as various generalizations of the model. "Technical efficiency gains are thus a movement towards use of "best practiced" technology, or the elimination of technical and organizational inefficiencies" (OECD 2001). However, not every form of technical efficiency makes economic sense. "This is captured by the notion of allocative efficiency, which implies profit-maximizing behavior by the firm through best allocation of resources" (OECD 2001). "One notes that when productivity measurement concerns the industry level, efficiency gains can either be due to improved efficiency in individual establishments that make up the industry or to a shift of production technology towards more efficient establishments" (OECD 2001).

According to the basic principle of economic rationality, the purpose is to achieve a given result with minimal resources or to get the maximum result with a given set of resources and technology (Vuorinen et al. 1998). However, it is not easy to measure the maximum level of performance in the production of services. Hence, it is important to examine the economic evaluation of service operations on the basis of the concept of productivity. Many studies have been undertaken in this context, and these will be examined closely in the literature review chapter.

Academics as well as international organizations such as OECD and World Bank have produced a number of studies on competitiveness. The "Global Competitiveness Report" and the "Doing Business Ranking" from the World Bank measure and compare the competitiveness of different countries. These reports are largely based on a productivity-based approach to measuring and comparing competitiveness. In order to identify and apply a precise definition of the terms and concepts that will be used in this research, the literature review chapter provides an intensive review on these issues.

1.4   The Objectives

Reflecting on the central role of the airline industry in the economy, many economists and institutions, including various government agencies, have analyzed and com-pared the performance and competitiveness of the international airlines. There are wide variations in the scope of analysis, both across different studies and over time.

These studies, however, have focused on highly specific issues based on origin and destination (O&D) such as route pair or city pair comparisons. According to Morrison and Winston (1987, 1990), O&D data best reflect competition among airlines, but such data is not readily available to researchers, except in the case of US international routes (see also Clougherty 2009). Considering the complexity of the airline business model and the econometric challenges linked with the analysis of issues of causality or measurement errors, this kind of approach is appropriate, especially in terms of theoretical soundness and the generation of useful information for the industry's business decision-makers.

An analysis of the global competitiveness of airlines needs to take into account not only firm-specific factors but also other situation-specific factors that airlines have to face in their competitive and highly regulated global market. Airlines' sustainable competitiveness in the global market is in fact the result of successful coordination between an overall business strategy and a well-designed market-specific strategy, which is chosen on a case-by-case basis depending on the market dynamics of each destination. Success in one particular route or city therefore does not guarantee similar results in the global market competition. Thus, instead of looking at specific routes or particular country pair comparisons, our analysis will include various strategies of main airlines such as alliances, pricing, aggregate flying frequency, and flying hours to reflect the airlines' overall strategies of their operation and sales in the global market for a period of 15 years.

Based upon the above conceptual framework and definitions, this paper will examine and provide answers to the following objectives. The first objective is to provide a comprehensive picture of developments in the airline industry and its contributions to the global economy in the recent decades. The second objective is to estimate the level of efficiency for individual airlines and changes in the efficiency of international airlines, and how this is related to their allocation factors both from production and cost function perspectives, namely, output maximization and cost minimization objectives, both of which are aimed at maximization of profits. The third objective is to investigate the components that affect the airlines' efficiency and temporal changes in relation to several characteristics such as firm's size, geographical location, specializations, and alliance memberships. The fourth objective is to investigate how airlines' efficiency affects airline's competitiveness in the global market.

In addition to providing an up-to-date presentation of the airline industry structure and conduct, this study makes at least three major contributions to the analysis of performance of the airlines with respect to competitiveness and efficiency. First, while there are many studies that analyze airline efficiency or productivity for specific routes, destinations or countries, there are only few studies which look at the overall population of major airlines from countries around the world. Second, there are few studies that link competitiveness in both production and cost, and jointly investigate the two as complementary. Looking at both sides of efficiency will improve the scope of interpretation by appropriately addressing the

issue of the efficiency in airlines, while simultaneously reflecting on the ongoing process of airlines' entry and exit from the highly evolving and competitive market. Such an approach is less likely to make a biased estimation on the global competitiveness of airlines. Third, this study uses up-to-date estimation methods and long time series of individual airlines covering substantial numbers of airlines from each region of the world including the Asian region, where there have been relatively fewer studies. Each of these three contributions is valuable in its own right, and we hope collectively they will make a valuable contribution to the literature by providing a clear picture of the performance and strategic decision-making of the industry.

1.5   Data and Methodology

Among the member countries and airlines of IATA, we utilize data from 39 international airlines, with the headquarters of operations based in 33 countries, during the period 1998–2012 (see Appendix 1.2). We chose 39 airlines among the top 50 carriers in terms of the 2012 output performance of airlines that were operating during the sampled period. In principle, we selected one carrier per country, but taking into consideration demand and market size, we included 4 carriers from the United States, 3 from China, and 2 from Japan. Some airlines were excluded from the data analysis and estimation procedure due to limitations in the data availability. The airlines' performance-related data was primarily collected from the Korean Government Official Statistics site (www.airportal.go.kr) as well as each airline's homepage. Country-based indicators in air transportation and travel data were collected from the World Bank, UNWTO, UNDP, and IMF databases.

In order to specify models consistent with the objectives and conduct estimations that are efficient yet robust, both theoretically and econometrically, we will first carry out our empirical analysis of airline efficiency using economic theory-based approaches—i.e., production function and cost function approaches. In the first case, the objective of airlines is to maximize output by using available inputs and technology, while in the second case, airlines aim to minimize the cost of producing a given level of services demanded, factor prices, and available technology (Battese and Coelli 1992, 1995; Kumbhakar and Lovell 2000). A cost function approach requires access to price information, which is neither readily available nor always reliable.

With the results from this process, we will then estimate the degree of production and cost efficiency for each airline and over time and explain the temporal changes in the degree of inefficiency in terms of possible observable determinants. In addition, the production model will be estimated by the stochastic frontier methodology, which allows estimation of efficiency parametrically and identifies and estimates effects of the determinants of its level and variations. Here, one

estimates a single production function but controls for different technologies and characteristics of airlines and markets to form a stochastic frontier representing the best-practiced technology. By doing this, cross-country differences in airlines' efficiency can be estimated and separated by their technology and market characteristics and differences.

The following chapter provides a review of studies on the airline industry, in particular studies on airlines' efficiency in the context of the characteristics of the airline industry and market. Chapter 3 provides an overview of airline characteristics, theoretical concepts, empirical models, and topical issues related to the industry such as "freedoms of the air" and "multilateral and bilateral agreements between the member countries." These are the areas of interest for industry participants and have implications for their business strategies. In Chaps. 4 and 5, 39 international airlines' production and cost efficiency will be estimated via stochastic frontier production and cost function models. In the conclusion, we will reveal the competitiveness position of the main and sub-variables affecting airlines' performance, survival, and growth in the industry, and discuss the factors that can increase the strength of the airlines' global competitiveness and contribute to global economic development, effectiveness, growth, and stability.

Appendix 1.1: US Carrier Exit and Entry Dates

Carrier	Carrier_name	Start_date	Thru_date
AA	American Airlines Inc.	1982-04-01	–
CL	Capitol International Inc.	1960-01-01	1984-12-31
CO	Continental Air Lines Inc.	1985-04-01	2011-12-31
DL	Delta Air Lines Inc.	1960-01-01	–
E0	EOS Airlines, Inc.	2005-10-01	2006-12-31
E0	EOS Airlines, Inc.	2007-01-01	2008-06-30
E8	US Africa Airways Inc.	1994-06-01	1995-02-28
EA	Eastern Air Lines Inc.	1985-06-01	1986-09-30
ER	Astar Air Cargo Inc.	2003-07-01	2010-12-31
ER	Astar USA, LLC	2011-01-01	2012-06-30
ER	DHL Airways	1992-04-01	2002-12-31
ER	DHL Airways	2003-01-01	2003-06-30
FF	Tower Air Inc.	1983-11-01	2000-09-30
FM	Federal Express Corporation	1986-01-01	1996-07-31
FT	Flying Tiger Line Inc.	1960-01-01	1989-07-31
FX	Federal Express Corporation	1996-08-01	–
MY	MAXjet	2007-01-01	2007-12-31

(continued)

(continued)

Carrier	Carrier_name	Start_date	Thru_date
MY	MAXjet	2005-11-01	2006-12-31
NW	Northwest Airlines Inc.	1960-01-01	2009-12-31
PA	Pan American World Airways	1960-01-01	1991-12-31
PE	People Express Airlines Inc.	1983-06-01	1986-12-31
PI	Piedmont Aviation Inc.	1987-06-01	1989-08-31
PO	Polar Air Cargo Airways	1996-05-01	–
QH	Air Florida Inc.	1979-01-01	1984-06-30
RP	Chautauqua Airlines Inc.	2012-07-01	–
TW	Trans World Airlines Inc.	1960-01-01	2001-03-31
TW	Trans World Airways LLC	2001-04-01	2001-12-31
TZ	American Trans Air Inc.	2000-01-01	2003-02-28
TZ	American Trans Air Inc.	1993-10-01	1999-12-31
TZ	ATA Airlines d/b/a ATA	2007-01-01	2008-06-30
TZ	ATA Airlines d/b/a ATA	2003-03-01	2006-12-31
UA	United Air Lines Inc.	1990-05-01	–
US	US Airways Inc.	1997-02-01	–
US	USAir	1989-08-01	1997-01-31
WO	World Airways Inc.	1980-06-01	1986-09-30
YX	Republic Airlines	2011-07-01	–

Source US DOT

Appendix 1.2: Airlines and Countries

Country	Sub total	Region	Tone rank	PAX rank	Airline	Airline code	Alliance	Starting year	AC	AC year
United States	5 countries 8 airlines	AM	1	1	American Airlines	AA	One word	1934	896	14.9
					UNITED airline	UA	Star	1931	704	13.3
					DELTA airline	DL	Sky team	1929	722	16.7
					US AIR	US	Star	1939	339	12.6
Canada		AM	12	8	Air Canada	AC	Star	1937	205	12.2
Brazil		AM	15	14	TAM Linhas Aereas	JJ	Star	1976	146	
Chile		AM	30	33	LAN Airlines	LA	One word	2004	107	5.1
Colombia		AM	31	42	AVIANCA	AV	Star	1940	71	6.9

(continued)

Country	Sub total	Region	Tone rank	PAX rank	Airline	Airline code	Alliance	Starting year	AC	AC year
China	12 countries 15 airlines	AS	2	2	Air China	CA	Star	1988	275	6.5
					China Southern	CZ	Sky team	1988	259	6.2
					China Eastern	MU	Sky team	1989	413	6.6
Hong Kong		AS	2	2	Cathay Pacific Airways	CX	One world	1946	134	10.3
Korea		AS	6	13	Korean Air	KE	Sky team	1969	130	9.4
Japan		AS	7	7	Japan Airlines	KJL	One world	1951	180	9.5
					All Nippon Airways	NH	Star	1953	151	12.1
Singapore		AS	9	17	Singapore Airlines	SQ	Star	1972	128	6.4
Australia		AS	13	12	Qantas Airways	QF	One world	1922	141	10.8
India		AS	14	11	Air India	AI	One world	1932	88	7.3
Thailand		AS	18	19	Thai Airways	TG	Star	1960	98	10.7
Malaysia		AS	21	21	Malaysia Airlines	MH	One world	1947	108	10.3
Indonesia		AS	26	23	Garuda Airways	GA	N/A	1950	81	6.5
Philippines		AS	29	28	Philippine Airlines	PR	N/A	1941	40	9.8
New Zealand		AS	32	30	Air New Zealand	NZ	Star	1940	98	9.4
Germany	12 countries 12 airlines	EU	3	4	Lufthansa,	LH	Star	1926	427	12.3
U.K		EU	5	3	British Airways	BA	One world	1919	240	
France		EU	8	6	Air France	AF	Sky team	1933	377	9.5
Spain		EU	16	15	IBERIA	IB	One world	1927	112	9.3
Ireland		EU	17	10	Air Lingus	EI	N/A	1036	44	6.7
Turkey		EU	20	18	Turkish Airlines	TK	Star	1956	189	6.4
Italy		EU	22	22	Alitalia	AZ	Sky team	1947	160	9.4
Switzerland		EU	23	25	SWISS Air	LX	Star	1931	91	
Sweden		EU	25	24	SAS Scandinavian Airlines	SK	Star	1946	143	12.9
Portugal		EU	33	29	TAP Portugal	TP	Star	1946	71	11.5
Finland		EU	35	34	Finn air	AY	One world	1968	68	8.4
Austria		EU	36	32	Austrian	OS	Star	1958	80	14.3

(continued)

(continued)

Country	Sub total	Region	Tone rank	PAX rank	Airline	Airline code	Alliance	Starting year	AC	AC year
Russian Federation	4 countries 4 airlines	EU	11	9	Aeroflot Russian airlines	SU	Sky team	1923	123	5.5
Qatar		EU	19	20	Qatar Airways	QR	N/A	1994	111	5.1
Saudi Arabia		EU	27	27	Saudi Arabian Airlines	SV	Sky team	1947	163	10.3
Israel		EU	34	36	El Al	LY		1949	40	13.4
33 countries and 39 airlines										

Notes *PAX* passenger, *N/A* not applicable

References

Battese G, Coelli TJ (1992) Frontier production functions, technical efficiency and panel data: with application to paddy farmers in India. J Prod Anal 3:153–169

Battese G, Coelli TJ (1995) A model for technical in efficiency effects in a stochastic frontier production function for panel data. Empirical Econ 20:325–332

Clougherty JA (2009) Domestic rivalry and export performance: theory and evidence from international airline markets, Canadian Economics Association. Can J Econ/Revue Canadienne d'Economique 42(2):440–468

Diewert WE, LawrenceD (1999) Progress in measuring the price and quantity of capital. Discussion paper 99-17, Department of Economics, University of British Columbia, Vancouver, Canada, V6T 1Z1

Heshmati A (2003) Productivity growth, efficiency and outsourcing in manufacturing and services. J Econ Surv 17(1):79–112

International Air Transport Association (2011) Vision 2050, Singapore, 12 Feb 2011 report. www.IATA.org

International Air Transport Association (2012) Annual report 2012. www.IATA.org

International Air Transport Association (2013a) Annual report 2013. www.IATA.org

International Air Transport Association (2013b) Profitability and the air transport value chain. International Air Transport Association economics briefing, No. 10. (www.IATA.org)

International Air Transport Association (2014a) Fact sheet: industry statistics. www.IATA.org

International Air Transport Association (2014b) Aviation benefits beyond borders, pp 2–8. www.aviationbenefitsbeyondborders.org

International Monetary Fund. http://www.imf.org

Kumbhakar SC, Lovell CAK (2000) Stochastic frontier analysis. Cambridge University Press, Cambridge

Kumbhakar SC, Wan H, Horncastle A (2015) A practitioner's guide to stochastic frontier analysis using stata. Academic

Morrison SA, Winston C (1987) Empirical implications and tests of the contestability hypothesis. J Law Econ XXX:53–66

Morrison SA, Winston C (1990) The dynamics of airline pricing and competition. Am Econ Rev Pap Proc 80(2):389–393

OECD Manual (2001) Measuring productivity—measurement of aggregate and industry-level productivity. http://www.oecd.org/std

Porter ME (1986) Competition in global industries. Harvard Business Press, Boston

Porter ME (1990) The competitive advantage of nations. Harvard Business Review, Boston
Pearce B (2012) The state of air transport markets and the airline industry after the great recession.
    J Air Transp Manage 21:3–9
Vuorinen I, Järvinen R, Lehtinen U (1998) Content and measurement of productivity in the service
    sector: a conceptual analysis with an illustrative case from the insurance business. Int J Serv
    Ind Manag 9(4):377–396
World Bank. http://www.worldbank.org, http://www.indexmundi.com/world/economy_profile.
    html