Evaluating competitiveness of airports - Airport competitiveness index

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EVALUATING COMPETITIVENESS OF AIRPORTS – AIRPORT COMPETITIVENESS INDEX

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Abstract
The paper introduces a concept of airport competitiveness index. The index consists of numerous indicators grouped into four categories: market potential, infrastructure, charges and recent traffic results. Another important factor we take into account is safety. We find that from the selected sample the most competitive airports are Singapore Changi, New York Kennedy, Newark Liberty and Dubai International. U.S. and South-East Asian airports in general are among the most competitive.
Key words: airport, air traffic, airport competitiveness index

Introduction

Why is it necessary to compose an index that would measure competitiveness of the airports? Although different airports concentrate on different user segments (intercontinental passengers, local passengers, air cargo traffic etc.) and thus are not in direct competition with each other, we believe this is just a consequence of historic factors. As liberalization, privatization and deregulation are conquering air transport, small unknown airports might become important regional, continental or global hubs in traditional hub-and-spoke systems. Other possibility is to concentrate on point-to-point traffic. Era of low cost airlines has brought new opportunities and challenges to the market. From among many airports we can use Bratislava, Slovakia (BTS) airport to illustrate the impact of the trend: in just 8 years from 2001 to 2008 the number of passengers using services of BTS airport increased nine-fold (from less than 300,000 to more than 2 million). Many other airports have achieved the same or even better results. This happened because they were competitive and prepared.

In other sectors of national economies comparable indices exist, although the situation there is similar – various companies concentrate on various customers, technically not being in competition with each other.

The aim of this paper is to develop an index able to evaluate airports according to their competitiveness. As this is the first version of the index, all the comments on how to enhance it will be greatly appreciated.

Literature review

Creating a global airport competitiveness index is a challenge that includes various pitfalls: The competitiveness of the airports in different parts of the world is influenced by different economic and political situation of the regions. Whereas economic differences are relatively easy to calculate, quality of infrastructure, political stability, level of air transport liberalization and other factors are not easy to measure. Due to these difficulties, to our best knowledge, there are no published attempts to compose a general index assessing airport competitiveness. However, various papers deal with this issue on a regional basis.

Park (2003) presents an analysis of the competitive status of major airports in the East Asia region, taking into account 5 dimensions: spatial factors, facility factors, demand factors, service factors and managerial factors. The most competitive airports are found to be the New Hong Kong International Airport, Singapore Changi and Seoul Incheon International Airport. The results correspond with an earlier study (Park, 1997) where other factors, such as geographical characteristics, socio-economic factors and environmental effects, had been used.

Reynolds-Feighan and McLay (2006) compare European airports based on their accessibility to regional, continental and global air transport networks. They concentrate on analyzing British and Irish airports, coming to a conclusion that apart from the London airport system, the most accessible airports are Dublin and Manchester.

Many other works assess financial performance and efficiency of airports (Barros and Dieke, 2007; Martin and Roman, 2008, etc). A common practice is using data envelopment analysis (DEA). Although good financial performance is vital for airport investors, we don't consider it an important factor for competitiveness. As long as the airport of interest provides all the necessary services in timely manner and for a reasonable price, airlines have no reason to give importance to this factor. Generally speaking, a bankrupt (but functional) airport with low delay times and low airport charges is always better than a saturated high-profit airport with all kinds of capacity problems.

There are also various rankings published annually assessing airports from the passengers' point of view. The most prestigious ones include IATA Global Airport Monitor and Airports Council International Airport Service Quality.

Methodology

There are two basic issues scientists have to deal with when composing an index: The main issue is to select the correct indicators to include in the index and to leave out from the index. The second issue consists in choosing the right weight of the indicators in the index.

The index we propose consists of four components: index of market potential (I_m), index of infrastructure (I_i), index of airport charges (I_{ch}) and index of previous results (I_t). Airport Competitiveness Index (ACI) presents a simple average of the four indices multiplied by the safety coefficient, as shown in the following equation:

$$ACI = 0.25 * SAF * (I_m + I_i + I_{ch} + I_t) \quad (1)$$

Each index has its own set of indicators, as displayed in the table 1.

Table 1: Composing the Airport Competitiveness Index

Indicator	**Abbr.**	**Low value**	**High value**
MARKET POTENTIAL			
Metropolitan area population	POP	0	3,000,000
Country GDP	GDP	0 USD	35,000 USD
Destination popularity	TRS	Neutral	Popular
Hub	HUB	Network carrier	None
Air transport liberalization	LIB	None	Both US+EU
INFRASTRUCTURE			
Road infrastructure	RDS	Poor	Developed
Public transportation system	PTS	Poor	Developed
Departure delays	DEL	100%	0%
CHARGES			
Airport charges (per B737-800 w/189 pax)	CHA	5000 USD	0 USD
Existence of curfews	CUR	Yes	No
RECENT TRAFFIC RESULTS			
Pax growth in the last 5 years	PAX	-100%	+100%
Number of airlines currently serving airport	ARL	0	20
Number of destinations served	DES	0	200
SAFETY	SAF	Alert	Sustainable

Index of market potential

One of the most important factors for a success of an airport is the size of metropolitan population living in the area (POP). More inhabitants mean more potential customers. The world has 19 agglomerations with more than 10 million inhabitants (so-called mega-cities), 49 agglomerations over 5 million and 431 metropolitan areas having more than 1 million inhabitants (UN, 2008). For airport competitiveness index purposes we decided to set the upper limit to 3,000,000 inhabitants – all metropolitan areas above this limit get the highest possible score 1.0. Smaller areas get scores that decrease with the size of population.

A metropolitan area airport in New York, USA and Lagos, Nigeria won't have the same market potential, although the size of area population might be comparable. Purchasing power is a factor we have to take into account. Therefore, country GDP per capita in purchasing power parity is an important indicator that cannot be omitted from the index. We set the 1.0 score limit to 35,000 USD. For USA we considered analyzing metropolitan area GDPs, however, as US GDP per capita is among the highest in the world, this step would be of no significance.

Another indicator to be taken into account is popularity of the destination (TRS). Even if an airport is in a vicinity of no big cities, it can flourish due to the tourist attractiveness of the region. A good example might be Punta Cana Intl. Airport in Dominican Republic. If we considered only the size of population to assess the market potential of the airport, 100,000 inhabitants would appear to be a very unsatisfactory number. However, the airport transported more than 3 million passengers in 2007. Therefore, it is obvious we have to include tourism factor in our index. Usually, tourism data is composed on country level. This is completely unsatisfactory for our purposes. We identified Forbes Traveler 50 Most Visited Attractions 2007 and Euromonitor International Top 150 City Destinations as being more applicable. An airport in a vicinity of any place ranked in top 50 of either of the abovementioned lists gets a score of 1.0. Other airports get 0.0 points.

HUB indicator is the fourth factor that might affect the number of passengers transported through the airport. If an airport is used as a hub of a network carrier, the number of its passengers will increase as a result of transfer passengers changing planes at the airport. We believe an airport where a strong network carrier is present has higher chances to attract new airlines. Therefore, an airport serving as a hub of a major network carrier is evaluated with a score 1.0.[1] Low cost carriers (LCC) are an important phenomenon of the new millennium – they have completely altered the patterns of air transportation market. They usually offer their services at secondary airports. However, as they normally concentrate on point-to-point service, they are less likely to bring transfer passengers. Airports with strong LCC presence get a score of 0.7.[2] Large airports (over 10 million passengers a year) not being a hub of any

[1] For purposes of the airport competitiveness index, a major network carrier is any network carrier on the Airline Business "The top 50 Full Service Network Carriers worldwide, 1st half-year 2007" list: American, Air France-KLM, Delta, United, Continental, Northwest, Lufthansa, British, US, Qantas, Singapore, Japan Airlines, Cathay Pacific, China Southern, Air Canada, Air China, Thai, All Nippon, China Eastern, Iberia, Korean, Malaysia, Virgin Atlantic, Alitalia, China Airlines, TAM, Alaska, Air New Zealand, Turkish, Scandinavian, EVA Air, Swiss, Aeroflot, LAN, Hainan, Asiana, Air India, Finnair, TAP, Philippine Airlines, Aer Lingus, Jet Airways, Hawaiian, Aerolineas Argentinas, Vietnam Airlines, Spanair, Brussels, Copa Airlines, Garuda Indonesia and Czech.

[2] Strong LCC presence means serving as a base for one of Airline Business "The top 25 Low Cost Carriers worldwide, 1st half-year 2007": Southwest, JetBlue, Ryanair, EasyJet, AirTran, Air Berlin, Gol Transportes Aereos, WestJet, Virgin Blue, Frontier, Jetstar, AirAsia, Spirit, Air Deccan, Germanwings, GB Airways, FlyGlobespan.com, Vueling, Norwegian, spiceJet, SkyEurope, Jet2.com, SilkAir, flybe and BRA.

major airline and airports serving as a hub of smaller network carriers get 0.4 points. All other airports get 0.0 points in HUB indicator.

An important factor is liberalization of air transport (LIB). Restrictive air service agreements (ASAs) are obstacles to efficient development of air transportation market. They set limits on route selection, capacity, pricing, number of designated airlines etc. and thus limit competition. On the other hand, liberal ASAs enable sound competition between airlines and between airports. Two largest air transportation markets, United States and European Union, signed an Open Skies agreement that came into force in March 2008. Although some restrictions still exist we consider their relations "liberal" and consequently all the EU and US airports get the highest score (1.0). Other countries get 0.5 points for having signed an open skies agreement with USA and 0.5 points for having signed a horizontal air service agreement with EU. If a country has no liberal ASAs with EU and USA, its score in this indicator is 0.0.

The following equation shows the method to count the Index of market potential (I_m):

$$I_m = 0.2 * (POP + GDP + TRS + HUB + LIB) \quad (2)$$

Index of infrastructure

Good infrastructure is one of the most important factors of success of any transportation network. For airports the two components of infrastructure are airport infrastructure and ground infrastructure. Airport infrastructure includes runways, taxiways, ramps, terminals and other facilities in direct control of the airport. Ground infrastructure consists of road and rail networks connecting the airport to the metropolitan areas in the region. Also, good public transportation system is vital.

Road infrastructure (RDS) connects airports with cities and enables passengers to arrive to the airport in time for their flight. To qualify as satisfactory (and get the score of 1.0), we require the airports to have a multi-lane highways connecting them with their metropolitan area. Other types of paved roads count as half point. If the airport has no paved road connection to the region it serves, the score is 0.0. Obviously, this is not a problem for any of the busiest airport in the world. However, if we expand our research to small regional airports in Africa or some Asian countries, the factor will play a much more important role.

Public transportation system (PTS) is not important only for people without their own transportation. It is an environmental and ideally also a very fast way to get to and from the airport. Traffic congestions in big cities make journey to the airport in one's own car unpredictable – depending on the level of traffic, times needed to travel the same distance vary substantially. Moreover, airports tend to charge high parking fees. Therefore, public transportation is becoming a preferred way of travel for time-conscious customers. We distinguish between four different modes of public transportation: high-speed train service, regular train service, subway and bus transportation. If the airport has a high-speed train connection[3] with the metropolitan area, the PTS score is 1.0. Regular train service is rated 0.75, subway 0.5 and bus service 0.25. We always take the highest score from all available transportation modes; thus an airport connected to the city with both regular train service and subway gets the score of 0.75 (and not 1.25). If there is no public transportation service at all (or if the frequency of service is less than 1 bus/hour), the PTS score is 0.0.

Saturation is a problem of many large airports. Probably the most notorious examples include London-Heathrow or Chicago-O'Hare. Saturated airports usually operate at full capacity and a slot allocation system has to be used to deal with the huge demand. The major

[3] To qualify as high speed, we require the trains to have an average speed of at least 100 miles/hour (160km/h) on the whole track from airport to the metropolitan area.

issue for airlines is that saturation causes delays, ineffective consumption of fuel and other costs. As there are no relevant statistics on airport saturation, we chose to use airport delay statistics (DEL). Bureau of Transportation Statistics has a top-quality up-to-date database on U.S. airport delays by causes. The point value of DEL indicator is calculated as share of flights departed on-time divided by 100. For non-U.S. airports we used various sources and estimates.

The equation for counting the Index of infrastructure is composed as follows:

$$I_i = 1/3 * (RDS + PTS + DEL) \quad (3)$$

Index of airport charges

An important factor when considering airport competitiveness are airport charges. As airport charges mean costs for airlines and revenue for airports, their height has to be carefully considered and balanced. According to general rules of market economy, economic subjects normally search for the lowest price for comparable level of services. The same principle is more-or-less valid in air transportation market. Especially low cost airlines exercise high pressure to keep the airport charges low. Only airports that want to discourage airlines from adding new flights (and above all to discourage low cost airlines) set high airport charges.

Airport charges normally consist of two different types – charges levied for aircraft movement and parking (usually charged per MTOW), and passenger charges (per capita). However, not all the airports follow this division. To mention an example, Adelaide Airport, Australia bases both charges on number of passengers. To exclude these differences from the research, we study airport charges as a whole.

We had to make a decision on what type of aircraft to include in our study. We settled on Boeing 737. There are various reasons: first of all, B737 is the most ordered jet airliner in history, with more than 5,800 aircrafts in operation and another 2,300 on order.[4] It is a short to medium haul narrow body airplane with low gas consumption and advanced technological equipment, all of these features making it an ideal aircraft of future for network carriers as well as for LCCs. When calculating this indicator we considered a Boeing 737-800 with MTOW of 79,010 kg (174,200 lb) landing at all the airports and departing after 30-minute turn-around time. If an airport has a differentiated rate policy, we always applied the highest daytime rate. We also included parking charges and air-bridge use (if applicable). When adding the charges levied per passenger we assumed full aircraft in 189-seat 1-class configuration. We also included airport security charges as they are charged per passenger as well. When international and domestic flight passenger rates are different, we used rates valid for international flights. Where applicable noise-based charges and other fees are included too. The 1.0 point level is set at 0 USD charges and 0.0 point at 5,000 USD.

Another issue is curfews (CUR). Curfews usually prohibit night take-offs/landings at the airports in proximity of residential areas. Another possibility is to close airports during certain times to save energy and labor costs; however, this is only possible for very small airports. Curfews are an obstacle for airlines – although the majority of them are valid at night only, they still limit the flexibility of flight scheduling. Airports with imposed curfews get the score of 0.0, whereas other airports get 1.0.

To sum up, we calculate the Index of airport charges (I_{ch}) as a simple arithmetic average of CHA and CUR:

$$I_{ch} = 0.5 * (CHA + CUR) \quad (4)$$

[4] See http://active.boeing.com/commercial/orders/index.cfm.

Index of previous results

Any analysis of competitiveness would be incomplete without adding the factor of achieved results into the research. Having this on mind, we include 3 different indicators in our study.

The first indicator concerns the number of passengers using the airport (PAX). We decided not to use absolute numbers, as their ability to capture trend is low. Rather we compare five-year growth rates of passenger traffic for each airport. Any decline or stagnation of traffic gets 0.0 points, whereas growth rates over 100 per cent are awarded with 1.0 point. Growth rates between 0 and 100% are rated proportionally 0-1.

The second indicator (ARL) studies the number of airlines operating flights from/to the airport in Winter season 2008/2009. We presume that the more airlines use the airport, the more competitive it is. We set the 1.0-point level to 20 airlines.

Finally, we include the number of destinations served (DES) into our study. Analogically as with ARL, when many destinations are served we consider the airport highly competitive. Especially European airports tend to have large number of possible destinations passengers can fly to. We decided to set the 1.0-point level to 200 destinations.

All in all, index of previous results (I_t) is counted as follows:

$$I_t = 1/3 * (PAX + ARL + DES) \quad (5)$$

Safety

The last indicator our index takes into account is safety coefficient (SAF). It is a country-specific indicator that can take values 0.5, 0.8 or 1.0, where 1.0 is the best possible result. We derive the values of SAF from the Failed States ranking composed annually by The Fund for Peace. The clue is as follows: 1.0 for countries ranked as "sustainable" or "moderate"; 0.8 for countries with "warning" and 0.5 for countries with "alert."

To summarize, taking into account equations (1)-(5) we propose to calculate the ACI as follows:

$$ACI = 0.25 * SAF * [(POP+GDP+TRS+HUB+LIB)/5 + (RDS+PTS+DEL)/3 + (CHA+CUR)/2 + (PAX+ARL+DES)/3] \quad (6)$$

Data

The following table presents the data sources for the components of ACI 2009. When calculating the values, we always tried to obtain the most up-to-date data from the most trusted source possible.

Table 2: Sources

Indicator	**Source**
POP	UN Urban Agglomerations 2007; official country sources
GDP	World Economic Outlook Database, IMF 2008
TRS	Forbes Traveler 50 Most Visited Tourist Attractions, 2007 Euromonitor International: Top 150 City Destinations, 2006
HUB	Official websites of airlines
LIB	List of open skies agreements, www.state.gov, 2008 Horizontal agreements, DG TREN, 2008
RDS	Own research, various sources

PTS	Own research, official websites of airports
DEL	Bureau of Transportation Statistics: Airport On-Time Departure Performance 1/2008-9/2008, Forbes Traveler, Association of European Airlines, own estimates
CHA	Official websites of airports, e-mails, own calculations
CUR	Airport Noise Regulations, Boeing.com, 2008
PAX	Airports Council International, 2002-2007 Official websites of airports
ARL	Database www.theairdb.com, November 2008
DES	Database www.theairdb.com, November 2008
SAF	Failed States Index 2008, The Fund for Peace

When calculating airport charges we found ourselves in a need of converting foreign currencies into US dollars. We used the following rates: 1.25 USD/EUR, 1.5 USD/GBP, 0.28 USD/AED, 0.62 USD/AUD, 0.53 USD/NZD, 0.1015 USD/ZAR, 0.66 USD/SGD and 0.0723 USD/MXP.

Airport competitiveness index 2009

The Airport competitiveness index 2009 ranking is based on calculations for 29 selected airports. The majority of these belong to the list of world's busiest airports measured by passenger traffic. However, as all of the busiest airports are in USA, Europe or Asia, we also decided to identify some additional airports from South America, Africa and Oceania and include them in our index.

Due to the abovementioned selection process and because we were unable to obtain all the necessary data for some airports, the list is not representative. A complete list would require analyzing hundreds of airports from all parts of the world – a thing that was not our intention, neither we possess the necessary resources. Therefore the list should be used only as a general guideline for illustrating the applicability of ACI index.

Table 3: Airport Competitiveness Index 2009

Rank	City	Airport	ACI	I_m	I_i	I_{ch}	I_t	SAF
1.	Singapore	SIN	0.85	1.00	0.78	0.95	0.68	1.0
2.	New York	JFK	0.85	1.00	0.72	0.83	0.84	1.0
3.	New York	EWR	0.80	1.00	0.81	0.70	0.70	1.0
4.	Dubai	DXB	0.80	0.67	0.67	0.97	0.89	1.0
5.	Atlanta	ATL	0.78	0.80	0.74	0.90	0.69	1.0
6.	Denver	DEN	0.77	0.75	0.67	0.94	0.70	1.0
7.	San Francisco	SFO	0.75	1.00	0.84	0.60	0.57	1.0
8.	Orlando	MCO	0.75	0.83	0.68	0.81	0.68	1.0
9.	Dallas	DFW	0.73	0.80	0.73	0.72	0.67	1.0
10.	New York	LGA	0.72	1.00	0.66	0.79	0.44	1.0
11.	Chicago	ORD	0.69	0.80	0.72	0.53	0.71	1.0
12.	Madrid	MAD	0.69	0.97	0.76	0.20	0.83	1.0
13.	London	LGW	0.69	1.00	0.85	0.19	0.72	1.0
14.	Charlotte	CLT	0.69	0.71	0.65	0.87	0.52	1.0
15.	Detroit	DTW	0.68	0.80	0.67	0.66	0.60	1.0
16.	Melbourne	MEL	0.68	0.80	0.65	0.66	0.61	1.0
17.	Paris	CDG	0.68	0.99	0.92	0.05	0.75	1.0
18.	Munich	MUC	0.63	0.88	0.78	0.06	0.82	1.0
19.	Amsterdam	AMS	0.63	0.87	0.91	0.00	0.72	1.0

20.	Sydney	SYD	0.62	1.00	0.85	0.00	0.64	1.0
21.	London	LHR	0.61	1.00	0.77	0.00	0.69	1.0
22.	Buenos Aires	EZE	0.61	0.58	0.63	0.50	0.74	1.0
23.	Cork	ORK	0.61	0.63	0.68	0.61	0.49	1.0
24.	Auckland	AKL	0.59	0.63	0.68	0.60	0.44	1.0
25.	Frankfurt	FRA	0.59	0.74	0.91	0.00	0.71	1.0
26.	Cairo	CAI	0.55	0.61	0.63	0.86	0.64	0.8
27.	Johannesburg	JNB	0.46	0.34	0.93	0.22	0.81	0.8
28.	Adelaide	ADL	0.43	0.61	0.67	0.00	0.45	1.0
29.	Montego Bay*	MBJ	0.32	0.71	0.37	0.10	0.43	0.8

* Montego Bay – TRS: we assigned this airport a score of 1.0, although it is not ranked on any of the considered lists. However, it is the primary gateway to Jamaica, one of the most popular vacation destinations.

Not surprisingly, the most competitive airports (from among the airports we studied) are in Asia and USA. The first place belongs to the Singapore Changi Airport – an airport that has received numerous awards for outstanding passenger service and quality. Although we didn't take these awards into consideration when calculating the index, our study confirmed that Changi really is a front-runner among airports. Another Asian leader, Dubai International is probably the fastest growing large airport in the world. The volume of its passenger traffic has more than doubled in the previous 5 years. Low airport charges, expanding Emirates Airlines and growing Middle Eastern air transportation market are among the factors that contributed to this development. We believe the importance of Dubai airport will grow fast over the next decade. Other Asian airports that were not included in the study (as e.g. Hong Kong International, Beijing International, Kuala Lumpur International or Taiwan Taoyuan International) would probably occupy the top ranks in the list as well.

The second and third places are held by two major airports in one conglomeration – New York. Kennedy International and Newark Liberty are traditional gateways to America for transatlantic passengers. In total there are 8 American airports in top 10. We believe it is a result of 30 years of liberalism in U.S. air transportation. The liberalization brought about higher efficiency in airline business and although ownership of airports itself was not liberalized, the positive effects spilled over to the airport business. Airports had to adjust to the new environment. Moreover, United States aviation market is the most competitive in the world and thus it is rational to assume that airports are highly competitive too.

The best European airports are Madrid Barajas at rank 12 and London Gatwick at rank 13. The major problems of European airports are high charges and existence of curfews. This is the reason why Frankfurt is only slightly better rated than the best African participant – Cairo airport.

Discussion

Our approach includes neither indicators of financial performance of the airports nor environmental indicators. Financial indicators of airports are of no significant use for airlines. As long as the airport of interest provides all the necessary services in timely manner and for a reasonable price, airlines have no reason to give importance to this factor. Although some airlines might take into consideration environmental factors, we believe in most cases it is airports that require adherence to strict environmental limits from the airlines.

Airport ownership is excluded form the ACI as well. Traditionally airports were owned by governments and local authorities; nowadays many airports are in hands of private investors. We don't want to take part in the private vs. public ownership debate and thus we decided to exclude the factor of ownership from the index.

Only passenger air transport, not cargo air transport was taken into account when composing the index. Air cargo market has its own rules and specifics and the structure of ACI for cargo airports would be very different from the one we propose.

There are also other factors that play a role in measuring how competitive an airport is, but we decided not to include them in the ACI. Just to mention a few, we omitted technical preparedness of the airports (for example whether they are ready to accommodate aircrafts of future, like A380), geographic location of the airports, prevailing weather patterns, costs of air traffic navigation etc. Even quality of service was omitted – we believe it is implicitly included in the index of previous results. High growth of passenger traffic and high number of airlines serving the airport should be considered an evidence of satisfactory level of services.

Airport competitiveness index is a new indicator in the field of air transport statistics and as such, it has all the mistakes any novelties do. Although we tried our best to assess airport competitiveness in the most objective manner possible, it might have happened we omitted some factors that are of importance. Therefore, we would appreciate any comments, criticism or suggestions that would make the 2010 version of the index better.

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