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AN INDEX OF CONVENIENCE IN THE AIR TRANSPORT INDUSTRY

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The demand for travel is a derived demand. Travelling is not desirable in itself but as a means of being at certain locations at certain times. The desire to be at a given location at a given point in time is derived from the need to undertake certain patterns of activities at that location. It is therefore easy to assume that an individual will want to minimize not only his travel cost, measured in dollars, but also his cost of travel, measured in actual time spent travelling.

Many attributes can affect the demand for travel. If travel demand attributes had to be summarized, in broad categories, such categories would have to encompass: the time required to travel; the cost to the user; and qualitative categories such as safety, comfort and convenience. If certain attributes can be applied to all modes of transportation, others are specific to air travel.

The intent of this study is to define an appropriate measure for a very specific attribute of air travel, the actual convenience of air services.

But the convenience of air services refers to a particularity of the service which is not easily measured quantitatively. Convenience is measured here as the cost in time to go from one point to another. The total trip time can be divided into several components: time spent flying, time spent at transfer points, time spent waiting for the flight or time lost due to a non-optimal arriving time. The total trip time is then largely explained by the convenience of the frequency and schedule of the service offered to the user.

The methodology chosen to evaluate the convenience of air travel in Canada, is an index approach. The index of convenience takes into account two main characteristics of air travel: the flight duration and the schedule delay. The flight duration is defined as the difference between the final arrival time and the (first) departing time. Therefore it includes the time spent connecting or waiting for a connection when a direct flight is not available. The schedule delay is defined as the difference between the scheduled arrival time and the ideal time at which the traveller would like to arrive.

An actual measure of the convenience of air services offered quantifies an important qualitative attribute of air transport demand. Such a measure can be useful in estimating or forecasting a demand function. It can also be helpful for other reasons. In the context of the reduction of the air transport industry regulations in Canada, an index of convenience can be used to monitor the effects of the policy changes on the convenience of air services as the services offered change. For the sake of comparison, the convenience of air services is measured from 1976 onward.

The index presented here was inspired by a CAB study[1]. The main assumptions are, however, adapted to the Canadian situation and some new methodological features are added.

Section I describes the sample used to measure the convenience of air travel in Canada. Section II explains the methodology used to compute the index of convenience as well as two other indices that are arrived at when distance and load factor are taken into account.

Sample

In Canada, a person can occupy a seat on an aircraft that can fly from various airports. The Canadian airport universe is limited, for the sake of this study, to airports receiving Class I and II services in 1978 and/or in 1983. The said airports are then divided into three groups: big airports, medium airports and small airports. There are eight big, six medium and 66 small airports. The sample includes all the big and medium airports and nine small ones. The selection of small airports followed the following process: two of them were randomly chosen in Ontario, two in Quebec and one in each of the following Provinces: British Columbia, Alberta, Saskatchewan, Manitoba, and Maritimes. From the sample of twenty-three airports (cities), various combinations of city pairs exist. From all the possible city-pair combinations, a sample of 54 is used. The sample includes 14 randomly chosen pairs which implies a link between a big airport and a big airport, 24 pairs involving a big airport and a medium airport, 7 pairs involving a medium airport and a medium airport and 9 pairs where a small airport is linked to a big airport. Table 1 presents a list of all 54 city pairs used in the sample.

Table 1

SAMPLE

1. Calgary-Montreal
2. Calgary-Ottawa
3. Calgary-Vancouver
4. Calgary-Winnipeg
5. Edmonton-Halifax
6. Edmonton-Montreal
7. Edmonton-Ottawa
8. Halifax-Ottawa
9. Halifax-Toronto
10. Halifax-Winnipeg
11. Montreal-Ottawa
12. Montreal-Toronto
13. Ottawa-Toronto
14. Toronto-Vancouver
15. Prince George-Quebec
16. Prince George-Kelowna
17. Regina-Saskatoon
18. Saskatoon-Quebec
19. Quebec-Sept Iles
20. Quebec-Kelowna
21. Sept Iles-Kelowna
22. Calgary-Saskatoon
23. Calgary-Sept Iles
24. Calgary-Kelowna
25. Edmonton-Prince George
26. Edmonton-Quebec
27. Edmonton-Sept Iles
28. Halifax-Quebec
29. Halifax-Sept Iles
30. Halifax-Kelowna
31. Montreal-Regina
32. Ottawa-Prince George
33. Ottawa-Quebec
34. Ottawa-Sept Iles
35. Ottawa-Kelowna
36. Toronto-Regina
37. Toronto-Saskatoon
38. Toronto-Kelowna
39. Vancouver-Quebec
40. Vancouver-Sept Iles
41. Vancouver-Kelowna
42. Winnipeg-Saskatoon
43. Winnipeg-Quebec
44. Winnipeg-Sept Iles
45. Winnipeg-Kelowna
46. Gander-Montreal
47. Iles de la Madeleine-Montreal
48. Matagami-Montreal
49. Sudbury-Toronto
50. Sault Ste Marie-Toronto
51. Churchill-Toronto
52. Prince Albert-Vancouver
53. Fort McMurray-Vancouver
54. Quesnel-Vancouver

Index of Convenience

The first index of convenience computed is based on the methodology developed by the CAB. The schedule delay and the flight duration are computed for hypothetical travellers on the 54 routes. These hypothetical travellers are assumed to have desired arrival times spread every fifteen minutes during the peak hours of the day.[2] For each of these travellers, an ideal flight is chosen from all the flights listed in the Official Airline Guide (OAG).[3]

The ideal flight is the one for which the weighted sum of the flight duration and the schedule delay is minimized. The weights are such that a traveller is willing to incur an hour of schedule delay for 45 minutes saved on flight duration.[4]

The index for one route is then calculated as the average for all passengers on that route and the total index is the weighted sum of the route's indices. The weights for the total index are the relative share of each route's origin-destination passenger[5] traffic.

Indexes of convenience can also be computed for sub-samples. For instance, the sample accounts for the size of the two airports from which a city pair is derived; also, for each city pair in the sample, a given length of haul separates the two cities. Table 2 presents the results of the index of convenience for the whole sample and disaggregated by city size and length of haul (route kilometres).

Table 2

INDEX OF CONVENIENCE

1976=100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	106.7	110.1	106.0
Big-Big	100.0	105.2	108.5	104.9
Medium-Medium	100.0	106.5	120.3	125.0
Big-Medium	100.0	108.4	103.1	99.4
Small-Big	100.0	141.1	145.1	140.3
less than 600km	100.0	102.6	87.2	104.7
601-1200km	100.0	126.3	113.5	112.1
1201-2400km	100.0	105.5	118.2	105.2
more than 2400km	100.0	95.6	91.8	85.5

*O-D data for the first three quarters of 1983 only.

The index has to be interpreted as a time cost index. In other words, when the absolute value of the index increases (decreases) from one year to another, it means that the cost, in time, to travel has increased or that the convenience has decreased (increased).

The index shows more variations in the convenience of the sub-samples of the Canadian routes than in the total sample. Between 1976 and 1984, the routes linking a medium city to another medium city face the highest decrease in the convenience of air travel. This is not surprising since people living in medium cities who intend to fly to another medium city often must go to a big city from which it then becomes possible to reach the actual medium city destination. For example, the travellers who want to go from Quebec

City to Kelowna have to go through the following travelling itinerary: Quebec City-Montreal-Vancouver-Kelowna. The measured decrease in convenience has happened mostly since 1982 and it coincides with the decrease in the volume of passengers carried by the air transport industry in Canada. Under the then difficult economic situation, carriers, in order to maintain their financial viability, were forced to rationalize their operations. The market of small to big cities stands as being the one with consistently the lowest convenience over the years. For small cities, the evidence indicates that the convenience of air services has neither improved nor deteriorated.

Index of Convenience Adjusted For Distance

As previously mentioned, the index of convenience takes into account the flight duration and the schedule delay. The flight duration is a function of three things: the speed of the aircraft, the time spent waiting for a connection and the distance between the origin and the destination. The last two are the most important aspects of the flight duration. However, if one compares two direct flights using the same aircraft type on two routes of different lengths, the flight duration is going to be higher for the longest route and the index of convenience, as defined, reflects it. To try to correct for such a bias, an index of convenience incorporating the length of each route in the sample is calculated. This index is computed in an effort to "deflate" the index of convenience for the different stage length of each route. Without such a deflator, it is believed that the index "penalizes" the routes with important lengths of haul. However, not all of the possible bias is removed since the directionality of the route in the context of the different time zones between the different parts of the country remains a source of concern in the defined measure of convenience. To go from Montreal to Vancouver doesn't take as much time as to come back.

Everything else taken into account, the inclusion of the distance factor is a valid way to aim at a standardization of routes but it cannot be done in a straightforward manner.

Table 3 presents the results of the index of convenience adjusted for distance.

The index adjusted for distance follows the same trend as the simple index in the sub-samples aggregated by length of haul. This may indicate that the adjustment for distance is not affected that much by the different time zones. In the total sample, the index adjusted for distance indicates a higher level of travel convenience in Canada than the level indicated by the simple index, especially between 1978 and 1979 and between 1980 and 1981. The measure of convenience has to take into account the fact that travelling from Quebec City to Kelowna has to take some time even in the best conditions possible because of the length of haul. Consequently, the index adjusted for distance indicates a better performance than the simple index.

Table 3

INDEX OF CONVENIENCE ADJUSTED FOR DISTANCE

1976 = 100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	105.5	106.9	101.2
Big-Big	100.0	101.4	97.5	94.6
Medium-Medium	100.0	112.5	124.7	129.7
Big-Medium	100.0	98.1	114.0	104.0
Small-Big	100.0	134.6	145.5	139.2
less than 600km	100.0	104.2	90.8	108.0
601-1200km	100.0	128.6	118.0	113.3
1201-2400km	100.0	104.3	116.6	104.5
more than 2400km	100.0	96.8	91.7	84.7

*weighted by first three quarters of 1983 O-D data only.

Index of Convenience Adjusted for Seat Availability

According to Douglas-Miller, travel time includes actual time in the aircraft plus two sorts of delay: frequency delay and stochastic delay. Frequency delay is the equivalent to what was called earlier schedule delay. Stochastic delay is the time lost due to the nearest offered departure time being unavailable. To take into account the stochastic delay, an index of convenience incorporating the load factor of each flight is calculated. If the load factor for a certain flight is very high, the probability that a traveller be denied a seat on that flight is very high. Therefore a high load factor for a flight reduces the possibility for that flight to be the one that minimizes the cost in time of the trip.

The load factors are unfortunately unavailable on a true O-D basis. Load factors are only available between every two stops the aircraft makes. Suppose one is interested in the load factor of a Montreal to Calgary flight. If the plane stops over in Toronto, two load factors are available: one for the Montreal to Toronto portion and one for the Toronto to Calgary portion. In cases where a flight with a stopover is involved, the highest load factor of all the flight's segments is the load factor used in the calculation of the index.

Load factors are not reported by all carriers. For smaller carriers like Great Lakes or Norcanair load factors are not available. Recently, however, small carriers have entered into markets which traditionally were served by bigger carriers. It is therefore important to take them into account in a study measuring the evolution of the level of convenience of air services. The sensitivity of the index was tested by allowing different load factors for flights with no reported load factors. Probably because of the small number of flights without reported load factors in relation to the total number of flights in the whole sample, the index was found insensitive to variations around a 60% load factor.

Because load factors are not yet available for the year 1984, the index has not been computed for 1984 with the load factor adjustment. The load factor adjusted index has also been calculated on different sub-samples disaggregated by city size and length of haul. Table 4 presents the results.

Table 4

INDEX OF CONVENIENCE ADJUSTED BY LOAD FACTOR

1976 = 100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	123.2	127.4	105.1
Big-Big	100.0	121.5	127.5	101.3
Medium-Medium	100.0	109.3	136.1	101.7
Big-Medium	100.0	129.3	113.7	117.1
Small-Big	100.0	170.0	177.7	140.3
less than 600km	100.0	113.6	108.9	74.6
601-1200km	100.0	137.3	126.8	118.0
1201-2400km	100.0	115.1	129.4	128.2
more than 2400km	100.0	118.8	121.3	97.9

*1983 weighted by first three quarters O-D data only.

The index of convenience adjusted with load factors follows more or less the same pattern as the other indexes but the peak and the through are a lot more pronounced.

It is interesting to note that the index adjusted for the load factor in the category big city to big city follows exactly the trend of the total sample.

Even if it is not the largest category in terms of the number of routes included, it is the category with the largest relative share of all origin-destination passenger and therefore it is the one that affects the average the most. However it may also be the one affected the most by the addition of the load factor since they are usually higher for the high density routes. This explains the big difference between the indexes with and without the adjustment by the load factor.

On the total sample, the year with the highest cost in time to travel or the lower convenience is 1980 and the year with the best convenience is 1976, except for the index adjusted by distance which shows 1981 to be the best year.

The CAB study from which the sample index of convenience is based shows results for the years 1978, 1980 and 1981 in the U.S. For the total sample, the Canadian indexes have the same behaviour which is a slight decrease in the convenience between 1978 and 1980 and then an increase between 1980 and 1981.

To summarize, the index adjusted by the load factor to take into account the stochastic delay is a step in the right direction even if the load factor is not the ideal measure of non-availability of a seat.

The indexes are now tested for sample sensitivity of medium-small cities. They will also be computed in the future as some effects of the liberalization of the air transport industry are expected.

FOOTNOTES

(1) CAB, Competition and the Airlines, An Evaluation of Deregulation, (December, 1982)

(2) Peak hours are from 9:00 to 11:00 and from 16:00 to 20:00 based on frequency of both eastbound and westbound flights.

(3) Flights for the first Monday of June in each year were taken for consistency throughout the period.

(4) The CAB tried several assumptions for the trade off and their year-to-year comparisons were not sensitive to the value of the trade off assumed.

(5) Statistics Canada, #51-204, Annual.

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