Airlines Operating Cost and Revenue: The Case of the Cameroon National Airline

Jacob Tche

Department of Economic Policy and Analysis, University of Yaounde II, Cameroon

*Corresponding author Email: *jacobtche1985@gmail.Com*

Received: 26,July, 2023 Accepted: 30,July, 2023 Published: 04 August 2023

Abstract

This paper attempts to provide a unique opportunity to calculate Cameroon domestic air transport operating cost and revenue. I explicitly introduce in my cost function the route distance of the domestic network in which carriers provide their services. Due to the declined in the domestic air transport routes in Cameroon, I proposed a hub-and-spoke network which influenced the operating revenue. My results, therefore, indicated that only two out of eleven routes are profitable. Consequently, to prevent huge shortfall in airlines revenues, I argued for the creation of the Domestic Network Sustainability Trust Fund.

Keywords: Cost, Revenue, Airline, Cameroon, Demand

1. Introduction

An airline's operating system is in economic terms a production process in which factors of production are combined to produce output. The quantities that can be produced are, in principle, based on the factors of manufacture employed and their efficiency with which they are harmonised; as is the quality of output. produced – but the single neoclassical production function specified in this paper follows the neoclassical assumption of homogenous output. However, a production function is a quantitative statement of the relationship between factor inputs used and the volume of the output produced – of alternative input combinations which may result in a given quantity of output or, on the other hand, an output that can be generated by any set of factor inputs. The main drivers of all production activities are available technology in the industry, but there is a clear need for management discretion as far as input choices and their deployment are concerned. It res A total cost function relates to output levels, and so helps provide insight into the impact of output changes on costs.

In many decisions made by airlines managers, costs for provision of air services are an important factor. It will be up to the purpose for which they are used to determine the way in which airline costs are broken down and classified. The information on costs is essential to meet the four main requirements of airline planning. In particular, as a general management and accounting tool, airlines need to determine in detail how much they spend on each of the various cost categories. Second, Airlines require detailed information on the cost of flights and routes, so that they may make decisions about increasing or reducing frequencies in a particular sector as well as for operating this route at all. Third, in developing pricing policy and price decisions for both passenger and cargo, it is essential to have a cost indication. Lastly, in all evaluation of investments it is necessary to assess the costs whether new aircraft are invested or not. The cost approach adopted in this paper is mainly influenced by the International Civil Aviation Organisation (ICAO).

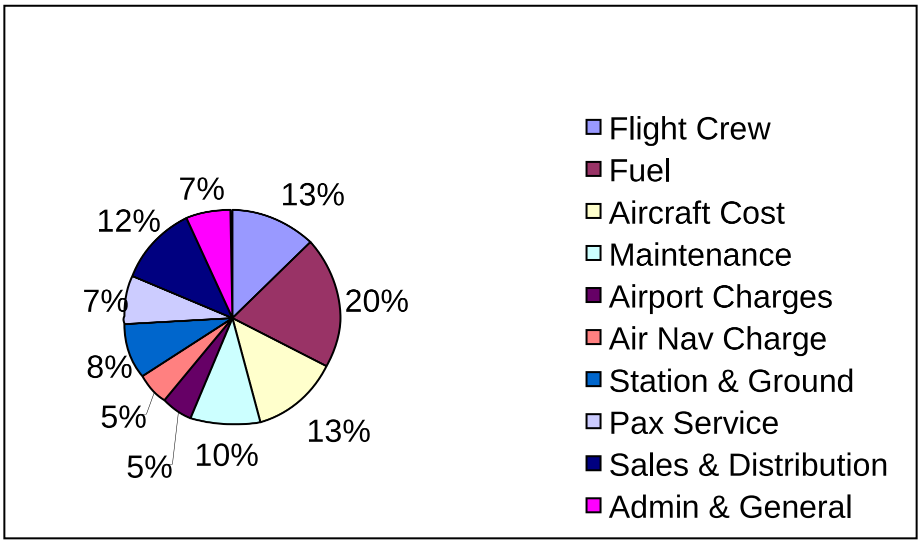
No published paper has tried to estimate airline operating costs and revenues in Africa in general and in Cameroon in particular. This paper, therefore, attempts to address this shortcoming in the following section by providing a unique opportunity to calculate Cameroon domestic transport operating costs and revenues.

2. Operating Cost and Revenue

In this section, I specify a single output neoclassical cost function. Neoclassical models assume homogeneous output and constant productivity of input factors over time.

The homogeneous output is produced over route of varying length and within markets of different densities. Therefore, a realistic characterisation of an industry's cost structure requires not only the incorporation of multiple inputs, but also the special characteristics of the route networks and changes in input productivities. Jacobsen (1968), Shephard (1970 and McFadden (1978) argued that the specification of an airline cost function may achieve consistency with optimising the input choices from neoclassical economic theory of the firm. However, my inputs choice has some limitations since the domestic air transport industry in Cameroon is not yet a fertile ground for aggregate time series data. Thus, estimated figures in this paper must be interpreted with care. Nevertheless, this potential source of error also applies to similar studies in many African countries. Using data from the Cameroon National Airline (CAMAIR-CO), I utilised the ICAO (2003) cost model to calculate a domestic operating cost function which is specified as follows:

Figure 1: Total Operating Cost (TC): The Overall Picture



Source: ICAO 2003.

Where

- Flight Crew (FC) includes salaries, expenses and training for the year related to all the personnel required to fly a plane in passenger service. The cost of flight can vary a great deal between carriers. In part, differences reflect factors such as the seniority of crew members and varying policies toward pay and benefits. Also crew costs can be higher if a carrier is forced to provide overnight accommodations for crews at an airport other than their homebased, thereby incurring hotel, meal and transportation cost.
- Aircraft Fuel (FU) represents the fuel uplifted over the year. Fuel consumption varies per aircraft type, depending on the number and the size or thrust of the engines and the type and age of those engines. During operation, actual fuel consumption varies considerably from route to route in relation to the sector lengths, the aircraft weight, wind conditions, the cruise altitude, and so on. It should be noted that in addition to aviation fuel, aircraft also use up oil. But the oil consumption is negligible. Rather than calculating it separately, I however include it in the total fuel cost.
- Aircraft cost (AC) includes lease rentals of the aircraft, insurance & uninsured losses, depreciation and amortisation. In the case of an airline taking an aircraft on a true operating lease, the aircraft is used for a relatively small proportion of its economic life and therefore does not have an economic interest in the aircraft beyond its current operational use. For the airline's income statements, operating lease rentals shall be reimbursed in whole or in part. On the other hand, insurance is the system or machinery by which it is sought to guard against the pecuniary consequences of certain accidents to which the operating company is liable, such as the loss of property by fire or wreck, or the loss of future earnings through disablement or premature death. Insurance does not attempt to prevent these accidents or even to protect against all the consequences of accident. The AC variable also includes depreciation. The purpose of depreciation is twofold. First, it aims to spread the cost of an aircraft over a useful life of that aircraft. Second, the depreciation allows money to be placed in a general reserve fund from each year's revenues that are equivalent to an impairment charge. These monies, together with any retained profits, can be used to pay back the loans with which the aircraft were bought together with any accrues interest. If the aircraft has been bought fully or in part with the airline's own cash, the accumulated depreciation reserve can be used to fund the new aircraft when the current aircraft is replaced.
- Maintenance (MA) represents the cost of maintenance and overhaul over the year. In practice there are so many joint costs in the separate maintenance areas that it is difficult, if not impossible, for many airlines to break total maintenance costs down into separate cost categories. Similar to ICAO, I group all maintenance and overhaul expenditure into a single undivided cost item. Maintenance costs cover not only routine maintenance and maintenance check carried out between flights or overnight but also the more extensive periodic overhauls and major checks. They encompass two major cost areas. First, the fact that maintenance work is carried out directly or indirectly involves a significant volume of labour and expenditure on all levels of staff. Secondly, there are significant costs to be incurred for the use of replacement parts. Station and Ground Charges, Airport Charges and Navigation charges (SG) entail landing and airport charges, route facility charges and station expenses. In addition to landing fees and other airport charges, station and ground costs shall be all those expenditures incurred by the airline in relation to its provision of service at an airport. Such costs include salaries and expenses of all airline staff located at the airports and engaged in the handling and servicing of aircraft, passengers or freight. These should include all costs associated with an airline's lounges for business or fist-class passengers. In addition, there will be the costs of ground handling equipment, of ground transport, of buildings and offices and associated facilities such as telephone and fax. The costs resulting from maintenance and insurance on the buildings and equipment of each station shall also be borne. The SG variable also includes airport charges and navigation charges. Airlines have to pay airport authorities for the use of the runway and terminal facilities. The airport charge generally consists of two elements: a landing fee relating to the weight of aircraft, which is typically its maximum take-off weight as well as passenger charges charged at the number of passengers passing through the airport. The second element included in SG is en-route navigation charges that airlines must pay to cover the cost of en-route navigation aids that their aircraft use while flying. The actual level of the navigation charge is related to the weight of the aircraft and the distance flown over the country air space. As a result, airport fees will vary according to the type of aircraft used in cases where they do not concern passenger charges and those for navigation services.
- Pax Service (PS) represents passenger services. The largest element of costs arising from passenger services is the pay, allowances and other expenses directly related to aircraft cabin staff and other passenger service personnel. Such expenses would include hotel and other costs associated with overnight stops as well as the training costs of cabin staff, where there are not amortised. Unlike pilots, cabin crew are licence to work on any aircraft type in an airline's fleet. There are no restricted to one or two types only. It is therefore assumed that the costs of a cabin crew are not affected by the type of aircraft to be used. On the other hand, certain airlines consider cabin personnel costs as an element of flight operation costs due to the differences in number and grade of staff on different types of aircraft. A second group of passenger service costs are those directly related to passenger. It also includes the costs of catering on board aircraft, accommodation provided for transit passengers, cost of meals and other facilities which are available at ground level in order to ensure passenger comfort as a result of delays or cancellations. Lastly, premiums paid by the airline for passenger liability

insurance and passenger accident insurance should also be included in the PS variable.

- Sales and Distribution (SD) include ticketing, sales and promotion. All expenditure, salaries, allowances etc. relating to staff involved in the reservation booking process, sales and promotion activity shall be covered by these costs. It would also include the cost of retail ticket offices or shops, whether at home or abroad, as well as the cost of telephone call centres and the operation of the airline website.
- Administration and General (AG) encompass administration and general expenses. These expenses are normally a relatively small element of an airline's total operating costs. They include cost elements which cannot readily be allocated to a particular activity.

The formula for the total operating cost for a given airline can be stated as follows:

TC = FC + FU + AC + MA + SG + PS + SD + AG

Caves, Christensen and Tretheway (1984) discussed the need to introduce route network distance in a cost function. I therefore explicitly introduce in my cost function the route distance of the domestic network in which carriers provide their services. Cameroon domestic air transport route is discussed below.

2.1 Air transport Domestic Network in Cameroon

The route network and destinations served by Cameroonian airports changed over the years since capacity to meet demand did not grow. As fares rose, some routes became unsustainable; particularly some regions of Cameroon such as the North West, West, the South and East did not have regular flights. Airlines tended to focus on more popular and more profitable routes at the expense of less profitable routes. The total number of destinations declined and, inevitably, domestic route network became eroded. A direct contrast of what prevails in other African Countries. Services related many of the less popular destinations are viable from the major region airports and so if they were to be dropped these regions may remain enclave. We therefore propose in this section a domestic route network spread all over the country, bringing provincial and administrative cities within easy reach of the capital – Yaounde - and the regional commercial centres.

A point to point system has been the tradition in Cameroon. For example CAMAIR-CO is currently serving Douala – Yaounde – Ngaoundere only. The other domestic routes have been neglected. Due to the geographical position of Yaounde in the centre of Cameroon as can be seen in Figure 1, we are proposing a hub-and-spoke network for the Cameroon domestic air transport system.

The literature on optimal network services demonstrates that a hub-and-spoke network is the most efficient configuration, used by most airlines in the industry . Airports such as Yaounde - Nsimalen with substantial capacity can support services to a wider range of destinations and a greater frequency of services than could be supported by local demand alone. This is because, according to the CCAA - Cameroon civil Aviation (2006), Yaounde airport can accommodate 1 500 000 passengers. In 2003, Yaounde – Nsimalen airport attracted more passengers than any other airport in Cameroon (CCAA, 2006). I assume that these passengers may need to connect from one flight to another, and airlines can therefore operate some routes that would not otherwise be viable at all and to offer more frequent services on routes that are already viable. The dense route structure served by Yaounde is proposed because Table 1 shows that more than 70000 domestic passengers boarded flights in 2003 form Yaounde – Nsimalen airport. A dense route network and higher frequency would bring significant benefits to domestic air passengers and to the Cameroonian economy.

For both business and leisure travellers, the main benefits of hub airports are:

- A greater number of destinations is served direct;
- The majority of destinations will be served at higher frequencies increasing convenience;
- The number of destinations served 'one-stop' from regional airports is increased;

Airlines will be able to pass some of the efficiency savings on to passengers in lower fares (on the other hand, if there is a dominant airline or alliance at the airport that will limit the competitive pressure on fares).

Table 1: Domestic Passengers

Year	Douala	Yaounde	Garoua	Ngaoundere	Maroua	Bertoua	TOTAL	GROWTH %
1997	59243	46498	33979	13230	22760		175710	
1998	60887	56827	38121	15875	20936	103	192749	9.697228
1999	67049	71818	39885	15085	26725	376	220938	14.62472
2000	80354	73228	42371	15747	24258	3129	239087	8.214522
2001	98112	79734	44083	23218	25409	2906	273462	14.37761
2002	89793	77739	44389	17508	21709	4589	255727	-6.48536
2003	63486	70891	49288	11918	15768	2261	213612	-16.4687

Source: CCAA various publications

In order to reduce connecting times for passenger, it is recommended that the hub location should be close to the centre of the network, allowing for an east-west and north-south configuration. In this paper, Yaounde – Nsimalen airport is selected as the hub, considering its close central location as showed in Appendix 1. In terms of passenger flow, Yaounde as the political capital has more demand for travel to the capital and political city.

However, the point to point or city-pair network would cause delay to passengers connecting since aircraft would have to move from one airport to another till the passenger find his connecting flight. Airlines are constrained in their ability to develop new services and increase frequencies on existing routes. The ability of regional travellers to connect easily to a strong route network is diminished.

According to Limão and Venables (2001), flight distance affects airline operating cost. The higher the number of domestic air transport routes in a given country, the higher the airlines operating costs. Cameroon domestic network will be boosted with the opening of more airports. My current network proposal can therefore be contrasted to the Cameroon present network where a point to point system has been the tradition with only Douala – Yaounde – Ngaoundere being served. Tables 2 and 3 show respectively flights distance and time in my proposed domestic network for Cameroon. The distance between Bamenda and Bafoussam is the shortest while it takes a record time of 103 minutes to flight between Maroua and Kribi.

Table 2:Route Network Flight Distance

Distance	BFS	BFD	BFR	MFE	DLA	GAR	KRI	YDE	MAR	NGD	TKO	
0 – 100	BMD			BMD							DLA	
101 – 200		YDE			FSM	BFS				GARGAR MFE,KRI		
201 – 300		YDE, KRI		YDE	YDE	DLA	BMD	YDE	DLA	KRI, DLA		YDE
301 – 400		BER		DLA	KRI,	YDE			BMD,	BER		MAR
401 – 500		BER,	NGD					NGD	BFS			
501 – 600				GAR	BER	NGD	BFS			MFE,BER		NGD
601 – 700				MAR			BMD	NGD	GAR			
701 – 800		MAR	MAR		GAR	GAR				YDE		GAR
801 - 900							GAR		DLA		MAR	
901-1000				MAR			MAR					
Source: Cameroon Civil Aviation (2006)												

Where BFS denotes Bafoussam, BMD Bamenda, MFE Mamfe, BER Bertoua, DLA Douala, GAR Garoua, KRI Kribi, YDE Yaounde, TKO Tiko, MAR Maroua and NGD Ngaoundere.

Table 3: Route Network Flight Time

Time (minutes)	BFS	BMD	BER	MFE	DLA	GAR	KRI	YDE	MAR	NGD	TKO
25-30	BMD										
31-35		MFE									
36-40	DLA			BFS		MAR					
41-45		DLA	YDE	DLA	KRI		YDE	DLA,BFS			GAR
46-50	KRI							BMD			
51-55		KRI		KRI				MFE	NGD		
56-60	BER	BER	DLA				BER			BFS	
61-65		NGD								YDE	
66-70			GAR	NGD						BER	
71-75	GAR		MFE		NGD						
76-80		GAR	MAR				NGD	GAR			
81-85	MAR					MFE					
86-90		MAR			GAR				YDE		
91-95							GAR				
96-100					MAR				MFE		
101 – 105								MAR			

Source: Cameroon Civil Aviation (2006)

Figure 2 presents my proposed network:

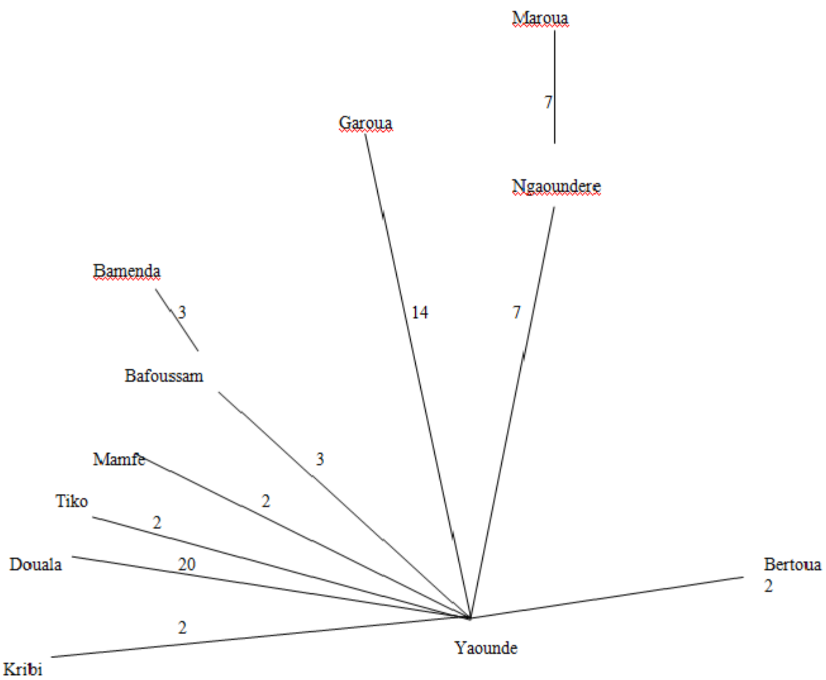


Figure 2: Hub – and – spoke Network with frequencies.

Figure 2, indicates that the Yaounde – Maroua route will be the longest route with 768 kilometres flight distance in 87 minutes. The Yaounde – Bafoussam route will be the shortest with 199 kilometres flight distance in 42 minutes using, for example, F 28 aircraft. Due to the economic capital status of Douala, flight frequency between Yaounde and Douala is proposed to be the highest with 20 trips weekly.

2.2. The Operating Costs Estimation

Using the model described in the last sub-section, I calculated the cost function for the Cameroon Airline Company. There are 10 parameters to be estimated in the cost function. I used the CAMAIR-CO actual maintenance amount and its corresponding percentage share as indicated in Figure 1 to estimate the total operating costs.

Table 4: Estimated CAMAIR-CO's Total Operating Costs

Flight Crew	1176177600[1]
Fuel	1809504000
Aircraft cost	1176177600
Maintenance	904752000
Airport Charges	452376000
Air Nav Charge	452376000
Station & Ground	723801600
Pax Service	633326400
Sales & Distribution	1085702400
Admin & General	633326400
Total Operating Costs	9047520000

On the basis of the 2003 total demand we can calculate the expected average cost per passenger.

2.4. The Operating Revenues

The bulk of air transportation revenues come from the carriage of passengers. According James (1985), 84 percent of revenue comes from scheduled passenger service, and another 2 percent comes from charter passenger services. Cargo services, including freight, mail and express account for 10 percent of revenue. Other services account for the remaining 4 percent. Table 5 shows the revenue breakdown.

On the basis of the current fare of FCFA 40000 for the Douala – Yaounde route, I spread a corresponding amount to other destinations proportionally to their distance. Table 5 indicates that the only profitable routes are the Yaounde - Garoua route making a record profit of FCFA 1,406,258,772 per year followed by the Yaounde – Douala route making a profit of FCFA 736,599,542 per year. The above table indicates that the routes Yaounde to Kribi, Bafoussam, Bertoua, Tiko, Mamfe, Maroua and Ngaoundere are not profitable. The less profitable route is the Yaounde - Mamfe route making a loss of FCFA 827,873,560 per year.

Table 5: Estimation of the Total Revenue

	Distance	cost/distance	Demand 2003	Expected Cost per pax 2003	Total revenue
Kribi	190	491,713,043	2,843	18,447	52,443,689
Bafoussam	199	515,004,714	14,334	19,320	276,938,447
Bamenda	247	639,226,957	18,723	23,981	448,988,447
Bertoua	220	569,351,945	2,261	21,359	48,293,204
Tiko	230	595,231,579	3,447	22,330	76,971,845
Douala	206	533,120,458	63,486	20,000	1,269,720,000
Garoua	640	1,656,296,568	49,288	62,136	3,062,555,340
Mamfe	335	866,967,735	12,024	32,524	39,094,175
Maroua	768	1,987,555,881	15,768	74,563	1,175,711,068
Ngaoudere	461	1,193,051,121	11,918	44,757	533,417,282
Total	3496	9047520000			6,984,133,495
Loss					-2,063,386,505

[1] 1 U.S. Dollar = 481 FCFA

Table 6: Estimation of the Total Revenue Increased by 29.54%

	Distance	cost/distance	Demand	Expected	Total revenue
			2003	Cost per	
				pax 2003	
Kribi	190	491,713,043	2,843	23,896	67,935,555
Bafoussam	199	515,004,714	14,334	25,028	358,746,064
Bamenda	247	639,226,957	18,723	31,064	581,619,634
Bertoua	220	569,351,945	2,261	27,669	62,559,016
Tiko	230	595,231,579	3,447	28,926	99,709,328
Douala	206	533,120,458	63,486	25,908	1,644,795,288
Garoua	640	1,656,296,568	49,288	80,491	3,967,234,187
Mamfe	335	866,967,735	1,202	42,132	50,642,594
Maroua	768	1,987,555,881	15,768	96,589	1,523,016,117
Ngaoudere	461	1,193,051,121	11,918	57,979	690,988,747
Total	3496				9,047,246,530
Loss					-273,470

Table 7 shows that should if I increase the fares by 29.54 %, CAMAIL will break even. However only the Yaounde - Douala and Yaounde – Garoua will remain profitable. The other routes will not be making profit but their loss level will be reduced.

Table 7: Estimation of the Total Revenue Increased by 29.54% in 2015

	Distance	cost/distance	Demand	Expected	Total revenue
			2015	Cost per	
				pax	
Kribi	190	491,713,043	3,895	23,896	93,082,018
Bafoussam	199	515,004,714	19,639	25,028	491,519,615
Bamenda	247	639,226,957	25,652	31,064	796,858,511
Bertoua	220	569,351,945	3,098	27,669	85,711,008
Tiko	230	595,231,579	4,723	28,926	136,618,876
Douala	206	533,120,458	86,980	25,908	2,253,483,739
Garoua	640	1,656,296,568	67,528	80,491	5,435,394,795
Mamfe	335	866,967,735	1,647	42,132	69,407,668
Maroua	768	1,987,555,881	21,603	96,589	2,086,636,772
Ngaoudere	461	1,193,051,121	16,328	57,979	946,709,373
Total	3496				12,395,422,37
Profit					3,347,902,375

My 2015 forecast in Table 6 shows a 3,347,902,375 FCFA profit in the domestic airline industry. The latter profit is generated by four profitable routes: Yaounde – Douala, Yaounde – Garoua, Yaounde – Bamenda, and Yaounde – Maroua. On the basis of the above forecast private airlines companies will be unlikely to run non profitable routes such as Yaounde – Kribi, Yaounde – Bafoussam, Yaounde – Bertoua, Yaounde - Tiko, Yaounde – Mamfe and Yaounde – Ngaoundere. To encourage tourism and the openness of regions in Cameroon, we recommend the creation of the Domestic Network Sustainability Trust Fund.

3. Conclusion

In this paper, I have specified and estimated a neoclassical single output cost function by looking at several categories of cost drivers. Since the homogeneous output is produced over route of varying length and within markets of different densities, a realistic characterisation of the domestic air transport cost structure in Cameroon has required not only the incorporation of multiple inputs,
But also the special characteristics of the route networks and changes in input productivities. With all major facets of the air transportation industry covered, I evaluated the total operating cost and revenue of CAMAIR-CO. My results show that the highest factor in determining the operating cost of a domestic airline company is fuel which amounted to 20% of the overall operating cost. Moreover, because routes distance was included after the evaluation of the total operating cost, the latter did not change but enabled me to calculate the operating revenue. With that said, routes distance still influences the level of the operating cost since the higher the routes distance in a given domestic air transport network, the higher the airlines operating costs.

Data Availability

All relevant data are within the paper andits supporting information files.

Conflicts of Interest

The author declared that there is no conflict of interest regarding the publication of this paper

Funding Statement

The author didn't receive any specific funding for this work

Acknowledgments

I would like to thank colleagues from national and international universities who agreed to proofread this work. They also contributed in improving certain parts of thre present article.

Supplementary Materials

There is no Supplementary Materials provided to be published along with the article.

References

[1] Cameroon Civil Aviation Authority, 2006. National Statistics, Yaounde: CCAA (2006)

[2] Caves, D.W., L.R. Christensen, and M. W. Tretheway, (1984), Economies of Density Versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ,Rand Journal of Economics, 21(3): 388:402.ICAO

[3] Jacobsen, S. E., (1968), Production Correspondences, ORC Report 68-8, University ofCalifornia at Berkeley.

[4] James, W.J., (1985) Airline Economics, LexingtonBooks: Massachusetts, Toronto.

[5] Limão, N., A. Venables, (2001), Infrastructure, Geographical Disadvantage,Transport Costs, and Trade. The World Bank Economic Review. 15(3):451-479

[6] McFadden, D., (1978), Cost, Revenue and Profit Functions in M. Fuss and D. McFaden (eds.), Production Economics: A Dual Approach to Theory and Applications, vol.2 (theory), North-Holland, 3-110.

[7] Shephard, R. W., (1970), Theory, Cost and Production Functions Princeton N.J.:Princeton University Press.

[8] Doganis R., (2002) flying off course. London: Harper Collins Academic Publishers Inc.

[9] Pitt, I.L. and J.R. Norsworthy (1999) Economics of the U.S Commercial Airline Industry: Productivity, Technology and Deregulation.