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RESEARCH

Testing the applicability of the low-cost carrier model in East African aviation market: A gravity demand model analysis

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Although there exists extensive literature on the demand patterns and long-term sustainability of low-cost carriers from numerous perspectives and in different markets, no research has examined its applicability to the East African aviation context. Therefore, this study aims to fill this gap by examining whether the European low-cost model can be sustainable against the backdrop of the challenges and complexities of the East African aviation environment. This article draws its theoretical literature assessment from the pillar of European low-cost carriers and gives a scope of the underlining strategic implications of operating a low-cost carrier model. Against such a backdrop, the African aviation market's operational complexities, challenges and opportunities, and demand patterns are presented in order to draw a conclusive evidence on whether a low-cost carrier in its current existence can be adopted in the East African market. Hypothetically, sufficient demand levels generally present the main barrier to operating an airline because, without revenue-paying passengers, operating costs cannot be covered. Subsequently, natural and latent demand levels on sample routes between the studied countries' major cities are forecasted using gravity modeling in order to determine whether current and future demand levels are sufficient to justify direct point-to-point flights between city-pairs on an aircraft at a typical European low-cost seating density. The findings suggest that latent demand could be stimulated on most routes by reducing ticket costs, thus justifying direct point-to-point services between the studied city-pairs on a typical European low-cost configured aircraft. Some routes, however, showed resilience to demand stimulation through airfare reduction. The study also includes a survey analysis of the general travel behavior of coach passengers in the East African market in order to understand their likelihood of switching from road transportation to air transportation. The findings underpinned the results found in the theoretical demand modeling.

Keywords: East Africa, low-cost carrier, sustainability, gravity model, demand

Introduction

Africa has long been lagging behind other world regions, not only in terms of economic development but also in terms of aviation expansion. It is inherent to acknowledge how air transport is a key enabler toward economic and social progress (1). Sarker et al. (2) presented an explicit statement by indicating that the air transport industry has traditionally been considered an integral part of major societies, communities, regions, and the global economy. In turn, this has prompted economic and social progressions in developed and developing nations, thereby providing access to global markets, international trade, and tourism. Although Africa's growth trajectory has shown positive signs, impediments still put a constraint on the industry gaining full momentum, and this is due to poor intra-Africa connectivity, unbalanced traffic distribution, higher (compared to the rest of the world) fares and airline operating costs, and sparse demand, and hampered by a restrictive and protectionist intra-African regulatory regime. It is also evident that the African aviation landscape has its inherent constraints due to other factors such as nonphysical barriers and inadequate infrastructure to accommodate the low-cost carrier (LCC) business model, hampered by high landing and navigation charges, high taxes, and restrictive market access through bilateral air service agreements (BASAs) (3, 4).

Few point-to-point providers, coupled with a rather poorly developed road and rail network infrastructure have faced challenges of generating significant passenger volumes. With such challenges, a LCC model could provide much-needed traction in terms of offering passengers alternative transport services and driving economic growth. LCCs' lean business models had historically proven to offer a compelling alternative at a time when passengers began looking for ways to avoid paying the high fares full-service network carriers charged in order to maintain their complex hub-and-spoke systems. Continuously, the world saw a growth of LCCs in markets such as the United States and Europe, which was later on followed by Asia after the liberalization of the Asian aviation market (5). However, Africa remains at the rim of this, only seeing LCCs in the northern Maghreb states as well as South Africa. LCCs are a relatively recent addition to the air travel market in Africa.

In comparison to the region's well-established full-service carriers (FSC), including Ethiopian Airlines, EgyptAir, and Kenya Airways, its budget airlines were all launched in the early 2000s. The LCC business model requires a liberalized market to be able to operate flexibly and at a low cost. Therefore, the reason why African LCCs were late starters was the absence of air service liberalization and a lack of deregulated frameworks.

The potential for low-cost aviation in East Africa from a demand perspective is what this study will aim to address by exhibiting an evaluation of the current business environment in East Africa. This study will focus on East Africa's strongest economies such as Rwanda, Uganda, Kenya, and Tanzania. The sample markets used in this study were adopted from the 20 territories due to their overall political stability, economic development, and supportive sociodemographic environment, which are all assumed to have a positive impact on the facilitation of air transportation.

Practicability and sustainability in this study refer to the sustainability of future demand that will ensure the survivability of regional air travel on the routes under research. It, therefore, neglects the environmental as well as social sustainability of the business model under study.

Literature Review

The overriding purpose of this study is to identify the practicability of the European low-cost model on the East African market. To assist the analysis, it is essential to identify the dominant product and operational features inherent in the low-cost business model. Many definitions have been put forward to define the term "business model." In its purest form, the term is related to a vehicle for delivering value (6) and was in later research further redefined by Lawton and Solomko (7) as delivering a value proposition to the customer. In other words, each element of the business model can be seen as a function of the value proposition. Many researchers have focused their attention on airline business models and their evolution, impact, and economic effects on developed economies (2, 5, 8–11), while a few have focused on a sustainable business model in developing nations (12–14).

The LCC model has continued to evolve by redefining the traditional characteristics that were pioneered by Southwest Airlines in the United States. For example, most LLCs such as Ryanair and EasyJet used the generalized principles of the "Southwest Effect," which may have fitted to the economic situation of the US or European market due to Open Skies. However, the African market, with its complex and rather diversified environment, will require more than just the implementation of the Yamoussoukro Declaration (YD) for LCCs to strive successfully (15, 16).

Thus, since the launch of LCCs continentally, only a few are still operating the original LCC business model to date. For example, Southwest and JetBlue no longer operate at a low cost or offer low fares (17). In other words, the airline industry has witnessed the advent of LCCs adapting and modifying the no-frills business model of the "Southwest Effect" to gain competitive and cost advantage over their competitors in their respective markets (18).

Nevertheless, it would be counterintuitive to assume that all European low-cost airlines operate the exact same model. Alamdari and Fagan (19) identified essential operational and product features that define the European low-cost model. An advantage of this model is that it scores the specific features for each LCC based on their similarities with the features of the original, US low-cost model. Alamdari and Fagan (19) outlined: "A score of 2 is assigned to a feature that is identical to the original model; a similar feature is scored 1; a feature that is completely different is scored 0. The total scores are indexed upto 100. If a carrier fully adheres to the original model, it will have an index of 100. The higher the total score for any carrier, the more their business strategy adheres to the original low cost model."

Analyzed with the help of Alamdari and Fagan's (19) scoring model, **Table 1**, highlighting Ryanair's and EasyJet's adherence to the original European low-cost model, emerges.

As can be seen from **Table 2**, Ryanair strictly adheres to the original low-cost model, resulting in an overall score

TABLE 1 | Features of the Purest Low-Cost Carrier Model and Scoring for EasyJet and Ryanair.

Category and feature	EasyJet	Ryanair
Network and tickets	**10**	**10**
Point-to-point sectors	2	2
No onward connections	2	2
No through-fares	2	2
No interlining	2	2
Only one-way fares	2	2
Services	**7**	**10**
No inflight frills	2	2
No seat assignment	0	2
Single-class cabin layout	2	2
No frequent flyer program (FFP)	1	2
No designated cargo handling	2	2
Distribution	**4**	**6**
High penetration of online bookings	2	2
No codes shares	2	2
By-pass of travel agency	0	2
Operational features	**6**	**8**
Fleet homogeneity	2	2
Average aircraft utilization > 8 h	2	2
Average stage length > 400 nm	1	2
Secondary and regional airports	1	2
Total score	**79.4%**	**100%**

Source: Authors. Bold values indicate the highest scores on the variables.

of 100%. EasyJet, on the other hand, has not implemented all aspects of the original low-cost model. EasyJet is, for example, between those LCCs that do operate from a few large hubs such as Paris Charles de Gaulle Airport and are listed in computer reservation systems (CRS). Moreover, EasyJet's service offering is much more advanced than the traditional low-cost model would permit. The airline has just recently implemented assigned seating and a frequent flyer program. However, since EasyJet charges its passengers for participating in the frequent flyer program, a score of 1 is given.

Through this evolution, the business model continues to emphasize its no-frills concept supported by a very aggressive cost-streamlining structure, which has enabled carriers to pass the cost savings to consumers through low fares (20). According to Statista (21), the LCCs have rapidly expanded their share of the global air travel market in the last 10 years or so and so far accounted for 35% of the world's total seat capacity. The great success the low-cost model has faced in Europe in recent years stems from an optimized network as well as organizational characteristics in a liberalized marketplace (22).

In academic literature, the sustainability of African low-cost aviation has only been studied in passing by Chingosho (23) and Herszenhaut (24), who presented some evaluation of the applicability of the LCC model in Africa and emerging regions in general. Herszenhaut (24) underscored two key barriers to the implementation of the model in emerging economies. These include the lack of high sales volumes and the fact that air travel is still viewed as a luxury in such economies. Both authors stress that only with the commoditization of air travel in Africa will the LCC model, in its true form, become viable. **Table 2** provides a summary of the key barriers to implementing the traditional LCC model success factors in Africa.

Despite these fundamental challenges, there are some attractive highlight markets in Africa that may be suited to the LCC model. This is based on the assertion that LCC models need thicker markets, as seen in the United States and Europe, to support the high utilization and frequencies with which the model is synonymous. As such, Nigeria (with a population of over 230 million), North Africa (Egypt, Algeria, Morocco, Tunisia), and South Africa (with a population of 58 million) are highlighted as LCC "hot spots."

The LCC business model has been studied extensively from numerous perspectives, including its sustainability ((25–30); among others) and feasibility (19) in different markets (31). Barrett (32), Mason (33), and Francis et al. (27) have studied the low-cost airline model from a demand perspective. Some research has been put forward to study the sustainability of various business models on the African continent, while the sustainability of the low-cost model on the continent was only studied in passing.

LCCs are a relatively recent addition to the air travel market in Africa. In comparison to the region's well-established Royal Air Maroc, South African Airways, Air Algerie (FSNCs), including Ethiopian Airlines, EgyptAir, and Kenya Airways, its budget airlines were all launched in the early 2000s. Despite the slow process, low-cost airlines have been launched in Africa. Since the early 2000s, several airline ventures have entered the market but almost half of them have not succeeded.

The LCC business model requires a liberalized market to be able to operate flexibly and at a low cost. Therefore, the reason why African LCCs were late starters was the absence of air service liberalization and the lack of a deregulated framework. After independence, the continent's governments established their own flag carriers, which have been supported and protected from competition and have prevented new market players, including LCCs, from accessing the air transport market.

It has been nearly two decades since LCCs began to penetrate the Middle East and African markets. Comair was the pioneer in Africa, launching its budget brand Kulula.com in 2001, and Air Arabia was the pioneer in the Middle East, launching operations in 2003. While the LCC sector in the Middle East and Africa has since expanded, the LCC model has hardly proliferated in the way that it has in other regions. Nevertheless, the East African Community is one of the only communities across Africa that has succeeded in liberalizing its airspace. In July 2005, the aviation bodies

TABLE 2 | Barriers to Low-Cost Carrier Model in Africa.

LCC success factor	Strength of barrier	Comment
Frequent services	Short-term barrier	African carriers fly to most destinations per aircraft in the world—combined with small fleets, this leaves poor frequencies and fragmented services
High utilization	Short-term barrier	Utilization in Africa is among the lowest in the world
High socioeconomic development	Short-term barrier	Africa's economy and its socioeconomic environment are highly developing. High disposable income across some regions in Africa mainly, EAC, SADC, and ECOWAS, to name a few leads to a rising middle class leaving potential for air travel
Favorable demand factors and high load factors	Needs to be studied in order to draw meaningful conclusions	Demand for air transportation in Africa was historically low due to high costs of travel, resulting in the world's lowest load factors
High labor productivity	Medium-term barrier	Labor force is costly, due to inefficiency and overstaffing
Modern aircraft	Medium-term barrier	Costly and inefficient aging fleet
No infrastructure constraints and presence of secondary airports	Long-term barrier	Lack of secondary airport infrastructure
High e-distribution	Long-term barrier	Low internet penetration and credit card usage
Deregulated aviation markets	Long-term barrier	Highly regulated markets with liberalization efforts being implemented at piecemeal pace, due to protectionist measures of national state carriers
Low-cost structures	Long-term barrier	Overall, airline cost structures in Africa are high due to monopolies and state protectionism

Source: Authors.

of Tanzania, Kenya, and Uganda agreed to harmonize aviation policies and regulations as well as to extend full privileges to airlines licensed and registered in the EAC (34). The implementation of the Yamoussoukro Decision and harmonization of regulation have already led to an increase in frequencies in the East African states, giving consumers more choices in carriers to travel with. The YD has been implemented within the East African Community but is not fully operational due to a number of challenges including state protectionism of small, unprofitable airlines and current low airport capacities, safety oversight, and security concerns. However, within the scope of the African Union Agenda 2063, the Single African Air Transport Market (SAATM) framework was launched in January 2018 to give the African-wide YD implementation new momentum. SAATM has been signed by 35 African countries willing to promote intraregional connectivity between African city-pairs by creating a single unified air transport market that could pave the way for a more competitive air transport market.

However, recent developments in socioeconomic infrastructure, coupled with a rising middle class and overall improvement in political stability, have altered the situation so as to provide a potentially more favorable environment for low-cost airlines in East Africa. The potential for low-cost aviation in East Africa from a demand perspective is what this study will aim to address by exhibiting an evaluation of future demand patterns on sample routes, as no airline business model can be successful without a substantial and sufficient amount of people willing to fly on this route.

An interest in modeling demand for air transportation began to appear in the literature during the early 1950s when the effort primarily focused on forecasting travel propensity between two points (35, 36). Alongside qualitative techniques used to predict air travel demand, a number of quantitative techniques have been used over time. These mathematical techniques primarily rely on time series and causal methods (37). Within time series models, demand forecasts are based on a series of past observations, assuming that the factors that influenced the past performance will continue (5). The suitability of using trend analysis, however, depends merely on the stability of historical developments and the certainty that the assumptions of continuing trends are appropriate also in the particular operating environment under study (38).

The applicability of time series models to existing routes in stable markets where no change in the future is likely to rule them out is a useful technique for this research.

Causal models use mathematical techniques to postulate precise, deterministic relationships where regressors and regress are identified, a functional form is specified, and a qualitative statement is made about the effects that occur when independent variables in the model change (39). In air travel demand, causal methods attempt to relate traffic level changes to selected socioeconomic variables. Dependent variables in the estimation of traffic demand are, in general, historical traffic data measured in terms of passenger volumes or tons of cargo. The explanatory variables are those variables that are known to have an influence on the demand for air travel.

Methodology

This section presents the econometric model adopted by this study to draw meaningful conclusions about underlying natural demand patterns in air passenger transportation between the sample countries: Kenya, Tanzania, Rwanda, and Uganda. The intention of the model development is to determine whether the volume of passenger traffic between the city-pairs is sufficient to justify direct, point-to-point flight connections between city-pairs, as inherent in the low-cost model. The advantage econometric modeling has over other forecasting techniques is the ability to produce useful forecasts on city-pairs that do not have direct air service connections, where there is no past development data, or on routes where historical datasets are inadequate or nonexistent (40), such as in the markets under research.

Estimating potential demand in the East African market is difficult due to the inherent difficulties in measuring demand growth in markets that are underserved and unequal, such as those in East Africa. In mature aviation markets, demand flows can be estimated from observed passenger numbers (41). However, in emerging markets, observed passenger numbers will underrepresent true demand, as a significant number of people interested in traveling between two points are prevented from doing so due to current limitations in service (42).

In academic research, gravity models gained popularity from the late 1950s, when passenger numbers were predicted by using simple gravity models employing population and distance variables and were later adapted to embrace other variables such as income, education level, the accumulation level of enterprises, and measures of city characteristics such as location advantages and climate (43, 44). More recently, Zhang et al. (45) applied the gravity model in China's aviation market using the Poisson pseudo-maximum likelihood (PPML) approach with fixed effects and concluded the benefits of increased air travel due to liberalization effects.

Gravity models are commonly derived from spatial interaction, where the magnitude of traffic between cities is similar to the gravitational pull between masses (37) and were chosen in the presented research as they assume that the strength of attraction between two places is conditioned by their economic mass and the distance between them is predicted to inversely affect the strength of attraction (46). The volume of traffic between the origin (i) and destination (j) is therefore given by the magnitude of traffic between cities and is thus similar to the gravitational pull between masses (47). In its simplest form, the model has the following functional structure (46):

Equation 1: Gravity Model Functional Form.

$$T_{ij} = \frac{\alpha \, P_i P_i}{d_{ij}^2}$$

where:

Pi and Pj are the populations of the origin (i) and destination (j),

dij is the distance between origin (i) and destination (j), respectively, in millions, and

∝ is a proportionality factor

Among the two approaches proven to be useful in estimating the model's parameters and predicting air travel demand—regression analysis and econometric analysis—this study considered an econometric analysis using doubly constrained distribution models as the most appropriate.

Dependent variable

The goal of this study is to predict the number of weekly passenger traffic between the sample countries' major economic centers using a number of explanatory variables known to influence air travel demand. The dependent variable is, therefore, the volume of weekly passenger traffic linking the major city-pairs in the sample countries. Since weekly passenger volumes on the respective routes were not publicly available, weekly capacity data for each city-pair in the period January 1, 2018, to December 29, 2019 (104 weeks) was taken from OAG Analyser. The cut-off time did not include the exogenous factor impact of COVID-19.

Explanatory variables

Population

The population variable theoretically and empirically represents the size of the potential of air travel between the city-pairs and has been applied differently in various econometric models such as country population catchment area and airport passengers. The variable includes domestic, regional, and international passengers but excludes transit and connecting passengers because of the point-to-point networks with no connections as inherent in the LCC model.

Airfares

Even though demand for air travel in sub-Saharan Africa is relatively inelastic, it was included in this model because demand for low-cost travel is suspected of showing more elasticity due to the high proportion of first-time flyers in Africa on LCCs, whose primary argument for flying is the relatively low fare. An average airfare on the city-pairs was taken from ITA Software. A cross-check of the routes under study was carried out, leading to the conclusion that all major airlines in the researched market are included in ITA. As ticket prices depend on the purchasing city, Dar es Salaam in Tanzania was chosen as the purchasing city and US Dollar as the preferred currency, as it is not as volatile as the East African currencies and is also used in East Africa as the favored payment method.

Model Generation

The presented study chose an exponential function to predict air travel demand on the routes under research:

Equation 2: Exponential Function.

$$f(c_{ij}) = \exp(-\beta c_{ij})$$

The following equation is derived from the above-mentioned model (Equation 2) and its further generalization. The replacement of distance by travel cost leads to:

Equation 3: Gravity Model Functional Form with Decreasing Function.

$$T_{ij} = \propto O_i D_j f(c_{ij})$$

where:

$\propto$ is a proportionality factor
$O_i D_j$ is the traffic between the origin (i) and destination (j)
$f(c_{ij})$ is a generalized function of the travel costs with one or more parameters for calibration

This model is also referred to in the literature as a "deterrence function" as it "represents the disincentive to travel as distance or cost increases" (46).

To meet the requirements of an exponential function, the single proportionality factor $\propto$ is replaced by two sets of balancing factors A_i and B_j, resulting in the classical version of the doubly constrained gravity model (41).

*Equation **4**:* Gravity Model Functional Form with Balancing Factors.

$$T_{ij} = A_i O_i B_j D_j f(c_{ij})$$

One can now subsume O_i and D_j into these factors and rewrite the model as

*Equation **5**:* Gravity Model Functional Form with Adapted Balancing Factors.

$$T_{ij} = a_i b_j f(c_{ij})$$

The values of the balancing factors A_i and B_j are, therefore:

*Equation **6**:* Value for Balancing Factor A_i.

$$A_i = \frac{1}{\sum_j B_j D_j f(c_{ij})}$$

*Equation **7**:* Value for Balancing Factor B_j.

$$B_j = \frac{1}{\sum_i A_i O_i f(c_{ij})}$$

TABLE 3 | Trip-end Totals matrix Including Target Estimation.

2011	NBO	DAR	JRO	Total	Target
KGL	2782	356	154	3292	**3496**
EBB	3410	499	210	4119	**4374**
MBA	6644	388	1093	8125	**8629**
Total	**12836**	**1243**	**1457**	**15536**	
Target	**13632**	**1320**	**1547**		**16499**

Source: Authors.

TABLE 4 | Cost Matrix for Gravity Model Estimation.

2011	NBO	DAR	JRO
KGL	132.00	177.10	112.75
EBB	99.00	84.78	96.00
MBA	73.15	191.95	186.00

Source: Authors.

TABLE 5 | Adjusted Fare Matrix for Gravity Model Estimation.

2011	NBO	DAR	JRO
KGL	13.20	17.71	11.28
EBB	9.90	8.48	9.60
MBA	7.32	19.20	18.60

Source: Authors.

TABLE 6 | Exponential function matrix and sums to prepare for Gravity Model Run.

2011	NBO	DAR	JRO	Total
KGL	0.3	0.2	0.3	**0.8**
EBB	0.4	0.4	0.4	**1.2**
MBA	0.5	0.1	0.2	**0.8**
Total	**1.1**	**0.7**	**0.9**	**2.7**

Source: Authors.

The balancing factors are interdependent. This means that the calculation of one set requires the values of the other set. This suggests an iterative process, which was solved using an Excel Solver.

First, we develop trip-end totals as well as a cost matrix for the gravity model estimation. The trip-end totals matrix contains a trip-end totals target, which was calculated with IATA's demand forecast for Africa of +6.2% for the coming years. We present the matrices in **Tables 3** and **4**.

In order to bring the cost matrix into an exponential function, the next step is to create an adjusted fare matrix, putting a weight ratio of 10% over the fare (**Table 5**).

Assuming that the best value of β is 0.10, a matrix of the values exp (-βc_{ij}) is built in a further step (**Table 6**).

TABLE 7 | Excel Solver Results.

2011	NBO	DAR	JRO	Estimation		Target	A	Ratio
KGL	2655.4	288.5	552.1	3496.1		3496	66.3118	1
EBB	3185.1	626.4	562.9	4374.4		4384	57.1821	1
MBA	7791.3	405.2	432.3	8628.8	**16499,2**	8629	108.014	1
Estimation	13631.8	1320.1	1547.3	**16499.2**				
Target	13632	1320	1547	**16499.2**		**16499.2**		
B	149.905	25.5719	25.71					
Ratio	1	1	1					
							Objective	0,0

Source: Authors. Bold values indicates the total number of trips where each cell is expanded in the matrix by the ratio 16499/2.7 = 6110.

TABLE 8 | Weekly Passenger Demand on Routes for the Next Years with 2019 as a Base Year.

	NBO	DAR	JRO
KGL	2655.4	288.5	552.1
EBB	3185.1	626.4	562.9
MBA	7791,3	405.2	432.3

Source: Authors.

TABLE 9 | Weekly Passenger Demand on Routes for the Next Years with 2019 as a Base Year.

	NBO	DAR	JRO
KGL	2720.5	292.1	483.5
EBB	3310.8	538.4	525.2
MBA	7647.5	490.1	539.1

Source: Authors.

With these values, we calculate the resulting total trips (Table 6: 2.7) and then expand each cell in the matrix by the ratio 16499/2.7 = 6110. This produces a matrix of base trips, which now has to be adjusted to match trip-end totals. To do so, the factors A_i and B_j must be calculated so that the constraints (Equation 8) are satisfied.

*Equation **8**:* Constraints of Factors A_i and B_j.

$$T_{ij}^{n} = \sum_{k} T_{ij}^{kn}$$

$$T = \sum_{ij} T_{ij} \; and \; t = \sum_{ij} t_{ij}$$

where:

T_{ij} is the number of trips between origin (i) and destination (j)
T is the total array
$T^{k}{}_{ij}$ are trips from origin (i) to destination (j) by mode k and person type n

The calculation of factors A_i and B_j is achieved in an iterative process, which in outline is as follows:

1. Set all $B_j = 1.0$ and solve for A_i; in this context, solving for A_i means finding the correction factors A_i that satisfy the trip generation constraints
2. With the latest A_i solve for B_j to satisfy the trip attraction constraints
3. Keeping the B_j's fixed, solve for A_i and repeat steps (2) and (3) until the changes are sufficiently small.

This process was carried out using Excel Solver, yielding the results shown in Table 7.

Demand forecasts for each route are then given in the framed matrix. Next, we conduct an analysis by adjusting the fare and/or demand forecast.

A limitation of this model, however, is that the constants A_i and B_j cause the model to fit an existing set of trip generation factors excellently, but due to the fact that these are constants, they might create great distortions in predicting the future (46).

Survey results

A coach passenger survey was carried out to gain an understanding of transport demand patterns and travel demand peculiarities in East Africa. Moreover, the survey intended to look at latent demand patterns and the likelihood of coach passengers switching from land transport to air transportation if favorable factors influence their decision.

The survey aims to identify latent demand factors. Since data for latent demand was unavailable, the survey analysis aimed at overcoming the data deficit. One advantage of the survey analysis is the opportunity to tailor questions specifically to the area under research in order to gain a more precise understanding of the general market circumstances, such as general travel behavior, gauge the level of importance passengers play on certain trip factors, and understand how certain trip factors, such as cost, accessibility, safety, and reliability of air transport, influence demand behavior in the markets and passenger price sensitivity.

TABLE 10 | Direction of Passenger Demand with No Change in Fare.

	NBO	DAR	JRO
KGL	↓	↓	↑
EBB	↓	↑	↑
MBA	↑	↑	↑

Source: Authors.

TABLE 11 | Weekly Passenger Demand on Routes for the Next Years with 2019 as a Base Year.

	NBO	DAR	JRO
KGL	2720.5	292.1	483.5
EBB	3310.8	538.4	525.2
MBA	7647.5	490.1	539.1

Source: Authors.

Sample size

A total of 500 respondents, ranging from 61 (Nairobi—Mombasa) to 109 respondents (Nairobi—Namanga), were obtained. The survey was conducted in June 2019 and face-to-face by field researchers and also self-administered by respondents to control for biases between these markets: Kenya to Tanzania, Kenya to Uganda, Kenya to Rwanda, and domestic Kenya.

It consists of 18 questions, of which 6 are open-ended and 12 are closed-ended. The scales used in the survey were rating scales. Upon the completion of the field execution of the surveys, the data was compiled in an Excel file, and the compiled data was then analyzed using IBM's SPSS statistics package.

Data analysis

This section presents the findings of the demand modeling and survey analysis on the routes under study in the intraregional East African markets of Kenya, Rwanda, Tanzania, and Uganda. As a first step, natural demand trends will be forecasted on the routes under study. Next, demand trends are analyzed in terms of their likely response to a change in airfare. Both analyses serve the purpose of estimating whether or not the expected demand is sufficient to justify direct point-to-point flights on respective city-pairs.

The argument for sufficiency is whether or not a typical low-cost aircraft—in this case, an Airbus A319 with a 145-seat configuration—can be filled at a load factor of 100% for at least one weekly return flight on the route. In a later step, the results from the empirical analysis are cross-checked using results from the survey conducted in Kenya.

TABLE 12 | Weekly Passenger Demand on Routes for the Next Years with 2019 as a Base Year When the Fare Is Cut by 50%.

	NBO	DAR	JRO
KGL	2765.5	292.0	438.6
EBB	3395.5	482.3	496.5
MBA	7470.9	545.7	612.2

Source: Authors.

TABLE 13 | Demand Percentage Change When Fare Is Cut by 30%.

	NBO	DAR	JRO
KGL	2.4%	1.3%	−12.5%
EBB	3.9%	−14%	−6.5%
MBA	−1.8%	20%	24.7%

Source: Authors.

TABLE 14 | Demand percentage changes when the fare is cut by 50%.

	NBO	DAR	JRO
KGL	4.1%	1.3%	−20%
EBB	6.5%	−23%	−11.7%
MBA	−4.1%	34%	41.7%

Source: Authors.

TABLE 15 | Direction of Passenger Demand When the Fare Is Cut by 30% and 50%, Respectively.

	NBO	DAR	JRO		NBO	DAR	JRO
KGL	↑	↑	↓	KGL	↑	↑	↓
EBB	↑	↓	↓	EBB	↑	↓	↓
MBA	↓	↑	↑	MBA	↓	↑	↑

Source: Authors.

Demand analysis—Gravity model

Applying the proposed gravity model to the routes under study, the demand forecasts arise (**Table 8**).

These figures in **Table 6** represent the demand forecast for the next years when fares are kept at the current average price level for each route. Comparing the current demand levels to the forecasted demand trends (**Table 9**), the demand outlook is widely positive.

Demand is forecasted to increase on most routes without a stimulation of latent demand through a reduction in ticket prices, as shown in **Table 10**. Nonetheless, without stimulation of latent demand through a reduction in airfare, traffic between Nairobi and Kigali, Nairobi and Entebbe, and Dar es Salaam and Kigali is believed to decrease if fares are kept at the current level.

TABLE 16 | Route Demand Analysis Results.

Route	Percentage of current fare	Estimated demand	Estimated current occupation	Estimated overspill for LCC operation	Estimated number of weekly flights at LF 100%	Estimated number of weekly flights at LF 67.8%
NBO-KGL	100%	2655	2208	447	**3.1**	**4.5**
	70%	2720		512	**3.5**	**5.2**
	50%	2765		557	**3.8**	**5.7**
NBO-EBB	100%	3185	3399	0	**0**	**0**
	70%	3310		0	**0**	**0**
	50%	3395		0	**0**	**0**
NBO-MBA	100%	7791	5965	1826	**12.6**	**18,6**
	70%	7647		1681	**11.6**	**17.1**
	50%	7470		1505	**10.4**	**15,3**
DAR-KGL	100%	288	135	153	**1.0**	**1.6**
	70%	292		157	**1.1**	**1.6**
	50%	292		157	**1.1**	**1.6**
DAR-EBB	100%	626	237	389	**2.7**	**4.0**
	70%	538		301	**2.1**	**3.1**
	50%	482		245	**1.7**	**2.5**
DAR-MBA	100%	405	0	405	**2.8**	**4.1**
	70%	490		490	**3.4**	**5.0**
	50%	545		545	**3.8**	**5.5**
JRO-KGL	100%	552	67	485	**3.3**	**4.9**
	70%	483		416	**2.9**	**4.2**
	50%	438		371	**2.6**	**3.8**
JRO-EBB	100%	562	329	233	**1.6**	**2.4**
	70%	525		196	**1.4**	**2.0**
	50%	496		167	**1.2**	**1.7**
JRO-MBO	100%	432	67	365	**2.5**	**3.7**
	70%	539		471	**3.3**	**4.8**
	50%	612		545	**3.8**	**5.5**

Source: Authors. Bold represents the data points from OAG flight analyser.

Since LCCs charge substantially lower fares than their incumbents, fare adjustments are made to predict whether or not a change in airfare may result in higher levels of demand and whether these demand levels are sufficient to justify the operation of a typical LCC aircraft model on the route. To study the potential for low-cost operations, the potential demand with a fare cut of 30% and 50% is forecasted. This yields the presented results in **Tables 11** and **12**.

However, most routes experience an increase in demand if the cost of travel decreases (**Table 13**). Especially the rise in demand on the route from Kilimanjaro to Mombasa is remarkable. Demand on this route is forecasted to rise by 24.7% if the fare is cut by 30% and by 41.7% at a 50% fare cut (**Tables 14**, **15**). Similar results can be found for the route Dar es Salaam to Mombasa, where a fare cut of 30% leads to a 20% increase in potential travelers and a 50% cut to a rise of demand by 34%. Therefore, both routes seem ideal for the stimulation of latent demand through a reduction in ticket fares.

One can conclude that other demand drivers must be present on these routes, which have a much stronger influence on the demand than the price for a ticket alone. This also indicates that a change in airfare cannot stimulate demand on tall routes, making it a difficult task for low-cost operators to operate on these routes as they solely stimulate demand through low fares and do not offer any additional services.

The conducted analysis for all routes showed the following results in **Table 16**. The route from Nairobi to Entebbe is, in terms of the number of airlines serving the route, the most densely operated route. Kenyan Airways, Air Uganda, and African Express Airlines serve this route with seven to nine flights in total per day, bringing a total weekly capacity of 5014 seats to the market. Adjusted by the average load factor for African airlines, the estimated weekly occupation is 3399.49 passengers. Due to less demand than actually offered seats, it is deemed unprofitable to start operations on this route if the argument is to fill an aircraft with the potential demand spillover alone. However, it could still be profitable if passengers switch to the LCC operator due to lower fares than those offered by incumbents.

The same pattern is prevalent on the route from Dar es Salaam to Kigali. With the demand spillover alone, a load factor of either 100% or 67.9% twice a week cannot be satisfied with the current demand spillover and neither with the spillover of stimulated latent demand. Dar es Salaam to Kigali was also among the routes where there seemed to be a price inelasticity of demand, meaning that demand cannot be stimulated by a reduction in airfare. A reduction of either 30% or 50% of the current fare only results in a demand increase of 1.3% (**Tables 11**, **12**).

The most densely operated route in terms of total weekly seat capacity is the domestic route from Nairobi to Mombasa. Indeed, this route is also forecasted to be the one that offers the most potential for the operation of a new carrier. Even though it does negatively react to the reduction of the ticket price, 12 weekly one-way flights can be operated from natural demand levels without a reduction in airfare alone at a desired load factor of 100%.

Dar es Salaam to Mombasa, as well as Kilimanjaro to Entebbe and Mombasa, are moreover among those routes that are deemed to be a good fit for the low-cost operator model in terms of weekly demand. All routes are served at a very little weekly frequency of currently two flights per week and very little competition from full-service network carriers. All three routes have the potential to be served at least once a week with a return flight.

Conclusion

In summary, the gravity model demand analysis shows that most routes present sufficient demand levels to justify direct point-to-point services. Demand on routes such as Kilimanjaro to Mombasa is very sensitive to a change in ticket costs, whereas on routes such as Kigali to Dar es Salaam, demand does not react to a change in airfare. It may be argued that the price elasticity on the route Kilimanjaro to Mombasa stems from a substantial amount of holidaymakers and VFR traffic. At the same time, Kigali to Dar es Salaam connects the countries' main business centers, therefore showing a very inelastic demand.

Nairobi to Entebbe and Dar es Salaam to Kigali were deemed unfeasible from a demand perspective. Kilimanjaro to Entebbe can potentially be operated if the desirable load factor to argue for the operation of a weekly return flight is set at 67.5%. Overall, the analysis showed an even split between those markets that react to a reduction of the ticket price with a growth in demand, and those where demand drops with a further reduction in ticket costs.

It is clear from the study undertaken that most routes present sufficient demand levels to justify direct point-to-point services between the sample city-pairs at a typical European low-cost aircraft configuration. Therefore, one can conclude that the European low-cost model is practical in the East African market from a demand perspective.

Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Authors' Contributions

CPK initially suggested the topic of study and conducted the early research. ES finalized the analysis to fit in the journal, and both authors conducted the empirical analysis.

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