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Towards a Theoretical Framework for the Allocation of Resources to African Air Transport

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Abstract

Tourism is essential to Africa's economic growth, yet it is constrained by the limitations of the airline industry. The African airline industry faces challenges which inhibit its ability to provide the level of air transport connectivity demanded to fully realise the potential of tourism, into and within, Africa. This study proposes a synoptic model which will enable the impact of the African airline industry's challenges to be assessed in terms of their effect on the tourism industry. This then lays the groundwork for a remediation strategy. In this qualitative study, data was collected through C-Suite face-to-face interviews with purposively selected senior managers in the airline industry. The study revealed the key challenges facing the African airline industry and proposed a conceptual model to enable informed decisions for improving airline connectivity. The major contribution of the study is the development of a proposed African Air connectivity Model which quantifies a connectivity measure as a proxy for distance in the gravity model of trade.

Keywords: Air connectivity models, African tourism, African airline industry, profitability

Introduction

To enable an assessment of the industry's limitations, the study proposed and tested a conceptual model of African airline connectivity as a basis for a cost/benefit analysis in a remediation strategy. The social value of this study may be understood in terms of Africa being home to around 1,3 billion people, the majority of whom are being systematically underdeveloped, and in many cases impoverished, by the failure of their economies to grow in tandem with the population growth rate (InterVISTAS, 2013). Airline transport linkages are key to developing tourism (Considine, 2013; International Air Transport Association [IATA], 2017; World Travel and Tourism Council [WTTC], 2018). Because of the inadequacy of road and rail transport linkages, airline connectivity is expected to bridge the transport gap. Thus, the limitations of the airline industry to meet this need can be considered relevant to the wellbeing of around one billion people. The scientific value of this study is threefold: First: the study systematically identified the challenges the African air transport industry faces. It did this through a survey of the literature, industry reports and conference proceedings. It then elucidated and verified this data by conducting face to face semi-structured interviews with airline industry Chief Executive Officers (CEOs). Second: the study advanced the application of the concepts of air transport connectivity. It did so by proposing and then validating a broad theoretical framework to assess the industry's limitations, and thus its restrictions, on African trade and tourism growth. Third: The validation of the model confirmed that the conceptual framework proposed by the study for the analysis of African airline connectivity could be used to inform policymakers and investors about the role and importance of air transport linkages on trade and tourism. The model could enable a cost-benefit analysis to be performed as the basis for a prioritisation of the challenges for a project-based remediation strategy. The cost-benefit analyses thus enable a more efficient allocation of resources to improve air connectivity.

The airline industry in Africa

In enabling the movement of people, the airline industry in Africa fulfils a key function in tourism (Morphet & Bottini, 2013; WTTC, 2018). However, Schlumberger (2010) and Oxford Economics (2017), note that the African airline industry has inherent limitations which inhibit its ability to provide the level of air transport connectivity required to fully enable the transport of both intra-African and extra-African tourists. The IATA defines the African airline industry as the 161 active airlines based on the African continent and associated islands (Matters, 2018). With few exceptions, these airlines are characterised by a lack of profitability, low yields and poor connectivity, which impact their efficiency and sustainability (Abate, 2016; IATA, 2016a). These and other challenges identified in this study account for the high failure rates for African airlines.

Schlumberger (2010), Morphet and Bottini (2013) and IATA (2017) posit that as a result of the high failure rate, state ownership and protection of state airlines and the associated lack of route liberalisation, amongst other factors, have impaired airline connectivity in Africa. Steyn and Mhlanga (2016) note that a key aspect of the lack of liberalisation is the reliance by states on restrictive bilateral air service agreements to limit the size and scope of airline operations, particularly competitors to home-state owned airlines. Heinz and O'Connell (2013) posit that airlines in Africa operate on thin margins because in general the airline industry is challenged by high fixed costs, cyclical demand, intense competition and vulnerability to external shocks. These and other factors make it difficult to operate airlines successfully. Heinz and O'Connell (2013:1) suggest that, in addition to these factors, African airlines are further challenged by challenges such as: "high costs; poor safety; government interference; corruption; low productivity and overstaffing; old aircraft; sparse demand over long sectors; low load factors; strong travel agent networks that operate in a cash economy; last minute booking profiles; low internet penetration; skills shortage; and difficulty in obtaining Air Operating Certificates (AOCs)." The net effect of this impaired connectivity is that many places in Africa are underserved by airlines in that there are few flights, and seats are prohibitively expensive, particularly when compared to competing tourist destinations. The consequences of limited air connectivity impact trade and tourism. Bofinger (2009; 2016) and IATA (2016a) argues that African airlines are failing the transportation and air connectivity needs within the continent. Oxford Economics (2011a) shows that the growth of both developed and emerging tourism markets requires a matching increase in air transport connectivity.

The African Development Bank Group (ADBG) (2017) posits that a key challenge to African growth is to develop intra-African trade and tourism, that is, between African states, and between the economic trading blocks. Of specific note in this regard is the proposed

African Union passport (Onwuka & Udegbunam, 2019) which would allow visa-free travel to all 54 member states, and initiatives such as the African Continental Free Trade Area, which includes 28 countries. The basis of these agreements is to develop intra-African trade and tourism, and it follows that to accomplish this there must be effective intra-African transport links. In this, they are part of a broader strategy to develop intra-African trade, which includes the launch of the Single African Air Transport Market (SAATM).

A key limitation of the African airline industry, as posited by the World Travel and Tourism Council (WTTC, 2018), is that internal tourism, particularly visiting friends and relatives (VFR) by air is yet to capture the African public's imagination. The WTTC (2018) report submits that tourism is key to African economic growth, yet currently, only 10% of Africans travel by air. The WTTC argues that given the current rate of economic growth and the emergence of a middle class, there should be a high demand for air transportation for tourism. Ishutkina and Hansman (2009) and ATAG (2016) argue that Africa should not become dependent on the low value-add of exporting primary production but should rather develop intra-African trade and tourism. However, Pakenham (1991) and Olamosu and Wynne (2015) amongst many others, argue that due to the colonial legacy, the ground-based transport infrastructure is not fit for the purpose of intra-African tourism. It is therefore argued by InterVISTAS (2013) and IATA (2016a) that, in the absence of an efficient intra-Africa ground-based transport infrastructure, air transport has a vital role to play in African tourism growth. Limited air connectivity hinders tourism by making it difficult for tourists to travel and thus, restricting the contribution of the tourism sector to economic growth. Morphet and Bottini (2013) argue that tourism reduces trade barriers and conversely, the hindrance of tourism may be expected to increase trade barriers. In the development of this study's theoretical framework, it was shown that the reduction of trade barriers permits producers to focus on their competitive advantages and thus participate in global value chains (Sydor, 2011), and by so doing, specialise and compete more effectively. It is postulated that this applies to tourism as well as to trade.

The African airline industry has been severely affected by the Covid-19 pandemic, IATA (2020) reports that in April 2020 African, "Capacity contracted 87.7%, and load factor dived 65.3 percentage points to just 7.7% of seats filled." This contraction of the African airline industry is expected to take at least three years to recover to 85% of its per Covid-19 levels (IATA, 2020). Although the World Bank has reduced its outlook for African economic growth from 2.4% in 2019 to between -2.1 and -5.1% in 2020, it is expected that, as a result of the Covid-19 pandemic, the airline industry will not have the capacity to match supply to tourist demand once the Covid-19 travel restrictions are lifted, (World Bank, 2020; IATA, 2020). Given the medium to long term outlook expected for African GDP growth in the 4% - 6% range (World Bank, 2020), it follows that any constraints on tourism imposed by limitations in connectivity created by the African airlines' challenges will increase if they are not addressed. Of particular relevance to this study's focus on intra-African tourism development arising from improved African air connectivity, is the notion of the 'glocal' nature of tourism development processes, as proposed by Milne and Ateljevic (2010). This indicates that the 'glocal', being the global and local (Intra-African), continental connectivity provided by the African air transport industry is fundamental to the development of the tourism industry.

Safety is a fundamental requirement of air transportation, more so than ground-based transport modes. Until 2015, Africa's safety record was nine times worse than the world average (López-Meyer, 2017). However, a remarkable improvement in safety standards was effected through the IATA Operational Safety Audit (IOSA). López-Meyer (2017) reports that for IOSA registered carriers, the 2016 accident rate, calculated as the number of accidents per million sectors, has reduced to 1.18 compared to a rate of 9.79 for non-IOSA carriers. In terms of aviation-specific infrastructure such as airports and air traffic management (ATM), Africa is characterised by poor ground-based facilities that affect both safety and airline efficiency. Pottas (2013) points out that the development of emerging tourism markets requires a corresponding increase in airport capacity and airline connectivity. If such an increase does not happen, Pottas (2013) posits that economic growth will suffer and that a Place (city) will become increasingly marginalised by being overlooked as an attractive tourist destination. IATA (2017) points out that the lack of investment in ground-based aviation infrastructure is a key limiting factor to airline growth. Poor navigation aids and airport infrastructure, inadequate human resources, and lack of connectivity are the key challenges.

The cost of airline tickets is a further key limitation for African air travel. IATA (2016b) points out that Africa has some of the most expensive airfares globally. Bofinger (2016) posits that African governments do not see aviation as a high-priority industry, instead perceiving it as a luxury. Chingosho (2012: 4) reports that African airfares 'are subject to excessive levies in the form of airport charges, fuel taxes, excise duties and more.' Shadare (2016: 2) observes that 'Fuel prices at some stations in Africa are over twice the world average. Then there are passenger taxes. An international traveller landing at Ambouli, Djibouti, should expect to pay up to $85.89 in extra fees, the highest on the continent. In Singapore, they amount to about $11. Mumbai boasts charges of less than $6. A two-hour flight from Accra to Sierra Leone can be between $800 and $1,500. It's ridiculous. Many Africans only fly when there's a conference and the conference is paying."

Air connectivity models

The key component of the study's theoretical framework is the concept of transport connectivity as articulated by Pearce (2007), and developed by Arvis and Shepherd (2011) and Shepherd, Shingal and Raj (2016) for the World Bank, and its subsequent application by IATA (2016b) and ATAG (2017). This broad concept of connectivity has been refined by numerous transport economists into a variety of indices that measure specific aspects of connectivity, some of which are used in this study. For the purposes of this discussion, the proposed African air connectivity model locates air connectivity improvements within the broad process of economic growth. In this process, connectivity is considered a proxy for gravitational attraction in the Gravity Model of Trade. This then enables the model to be used to quantify an increase in a place's competitive advantage, and thus, for this paper, its ability to compete in the tourism market.

In terms of the theoretical framework for this study, it is important to consider the relationship between tourism flows and GDP. Caglayan, Sak and Karymshakov (2012) and Shakouri, Yazdi, Nategian and Shikhrezaei (2017) identified a bi-directional relationship between tourism and economic growth – as measured by GDP. On this basis, where applicable for the purposes of deriving a conceptual model, this study uses economic growth as a proxy for tourism growth. However, it is recognised that one of the methodological challenges in using GDP data as a proxy for tourism growth is that it is driven by factors other than purely air connectivity as well as extraneous influences such as exchange rates. As a practical illustration of the importance of air connectivity to tourism, the Western Cape Air Access initiative has demonstrated remarkable results in increasing tourism to the Western Cape in South Africa by encouraging more airlines to fly to Cape Town, thus, increasing connectivity by increasing the supply of seats and the frequency of flights and making ticket prices more competitive, (Wesgro, 2020). This study identified five connectivity models as a basis for the conceptualising and then the measurement of key elements of African air transport connectivity. These five models are:

The air connectivity index

The survey of the literature indicated that the most widely used air connectivity metric, both in its own right and as the point of departure for other air connectivity measurement methodologies, is the broad-based Air Connectivity Index (ACI). Arvis and Shepherd (2011) developed the ACI as a synoptic high-level measure of a country's ability to compete in the global air transport network.

The e-freight friendliness index

A key component of post-Covid-19 air connectivity is the ability to process passengers with a minimum of in-person touch points through the terminals, and this includes baggage handling. In this regard the Smith and Moosberger (2009) e-Freight Friendliness Index (EFFI), is a key proxy for the measurement of these capabilities.

The air liberalisation index

This was developed by the World Trade Organisation (WTO, 2006) as an index to quantify the extent of deregulation and liberalisation of passenger air services. Surovitskikh and Lubbe (2016) note that the Air Liberalisation Index is a key component of the Quantitative Air Services Agreements Review (QUASAR). This is a World Trade Organisation database (WTO, 2006) using the base year of 2005 to measure air services between 200 countries.

Business connectivity index

York Aviation (2004) developed the Business Connectivity Index (BCI). The BCI goes beyond the quantification of the economic contribution of connectivity by also addressing the comparative contribution that infrastructure such as airports, or services such as feeder airlines, provide to enable tourism.

The gravity model of trade

The key mechanism used by this study to evaluate the impact of connectivity improvements in Africa was the Gravity Model of Trade, (Wilson, 1970). This model proposes that for economic modelling, the physical force of gravity is useful as a descriptor of economic interaction between countries. The key postulate of this model is that the distribution of goods, or less tangible services, across space, is determined by forces that mimic the attenuation of gravitational force over a distance. The model has proven itself useful for modelling tourism flows, having been used to model the relationship between dyadic data such as tourist safety and communication effectiveness.

Other indices

For the purposes of proposing a synoptic model for African air connectivity consideration was also given to synthesising a number of other models. These are the Air Trade Facilitation Index, (Saslavsky & Shepherd, 2012) and the Logistics Performance Index (World Bank, 2018). However, these models are more specifically focussed on trade than tourism and are listed here only as they are referenced later in this article.

Synthesising air connectivity models

By synthesising key components of the various conceptual models, a synoptic model for the determination of the impact of the limitations of the African airline industry on connectivity, and thus on tourism, is proposed. This model will, for example, assist in answering the question as to whether governments should subsidise their national airline, or alternatively, the fund increased airport capacity for private sector airlines. The conceptual model for African transport efficacy is based on the researcher's concept of the 'friction of distance', which may be described as the difficulty of moving people in terms of costs and time. This concept of the friction of distance is assimilated by this study for integration into a proposed holistic Model of African Air Connectivity (Figure 1).

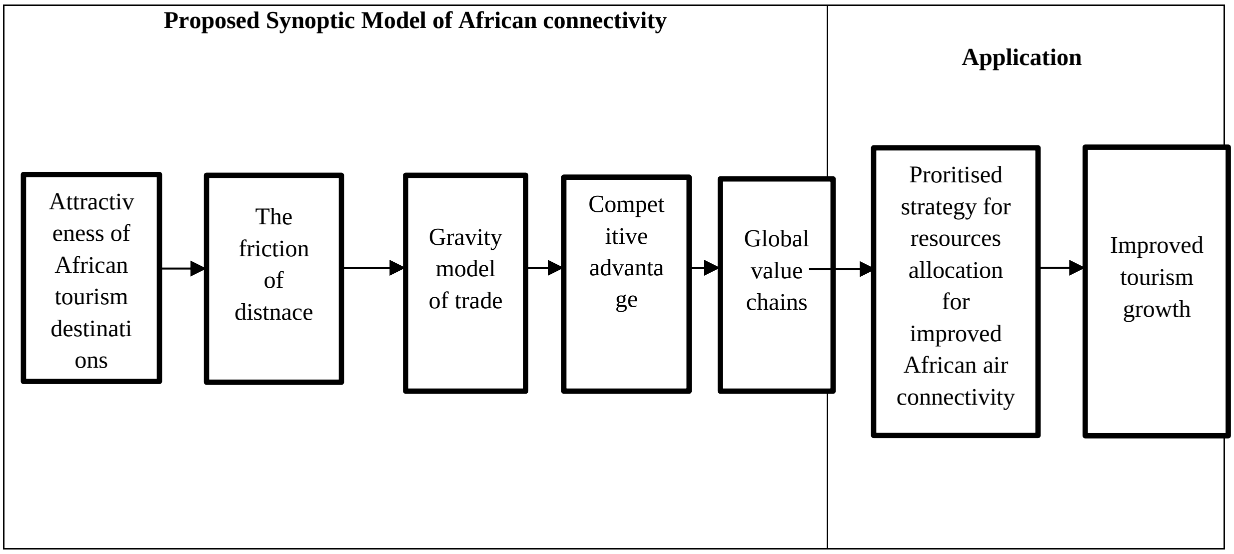

Figure 1: The proposed synoptic model of African air connectivity
Source: Leitch (2020)

Methodology

This study used an exploratory research design as this was appropriate to the study's interpretivist paradigm. The study's location within an interpretivist paradigm is determined by the primary data gathering process which involved semi-structured interviews with purposively selected key industry leaders. C-suite interviews provided an opportunity for exploration where the researcher probed for clarity. The overall research strategy involved the definition, assimilation, study, analysis and integration of the inherent limitations of the African airline industry into an integrated model of African air connectivity. Data were derived from three preliminary data sources – being: the literature review, industry reports and the analysis of connectivity models. The literature relating to key aspects of the African air transport industry was surveyed to inform the construction of a theoretical framework. This theoretical framework provided the structure for the generation of a model to inform the prioritisation of the identified limitations of the industry. The broad overview of the key challenges facing the African air transport industry provided by the literature review informed a review of key Industry Reports. These industry reports are particularly useful as they contain information which specifically addresses the challenges faced by the African air transport industry. A range of conceptual methodologies of modelling connectivity was examined. Not all were specifically designed to model air connectivity, but those not designed for air connectivity nonetheless have useful concepts and formula which may be applied to the analysis of African air connectivity.

The proposed African air connectivity model (AACM)

After accessing the weaknesses and limitations inherent in the existing models of air connectivity, it became evident that this study needed to propose a synoptic model for African air connectivity in order to generate a metric for 'the friction of distance' that could be applied as the quantitative distance vector for input into the Gravity Model of Trade. This proposed model enables an assessment of a country (or producer or Place's) competitive advantage, and thus its ability to compete for tourists. This study was spared the resource intensive task of having to generate its own data set on air connectivity to test the proposed model by the existence of the broad-based ACI. The ACI uses data from the worldwide SRS Analyser which has the advantage of having data for African countries. By using flight schedule data from the SRS database, Arvis and Shepherd (2011) were able to consider the relative size of both Origin-Destination (O-D) pair points and their relative gravitational attraction. Of vital importance to this study for testing its proposed AACM, sufficient data were available for Arvis, Saslansky, Ojala, Shepherd, Busch, Raj and Naula, (2016) to have calculated ACI metrics for Ethiopia for 2006, some years before the index was derived.

Towards a synoptic African air transport connectivity model

To develop the proposed AACM to evaluate the impact of the challenges faced by the African air transport industry on African tourism, the researcher considered the aggregation of the various indices, and in response to guidance from Dr Ben Shepherd of Developing Trade Consultants, considered combining and weighting five of the key indices as shown in Table 1 below.

Table 1: Proposed composition of composite AACM Indices

Metric	Weighting
Air Connectivity Index:	50%
E-freight Friendliness index:	20%
Air Liberalisation Index:	15%
Logistics Performance Index:	10%
Air Trade Facilitation Index:	5%

However, conceptually it was recognised that there is a risk that the indices may not be sufficiently comparable to aggregate. For example, the key ACI has a very narrow range with most scores between 0.02 and 15, whereas the ATFI has a score range from 6 to 100. To balance the variation in the range of scores, this study calculated a mean score for each metric and applied a balancing factor, as can be seen in Table 2 below.

Table 2: Balancing and Weighting of selected Connectivity Indices to produce a composite AACM

Metric	Score range	Mean	Balancing factor	Weighting (%)
Air connectivity index:	15.0-0.02	7.5	13.33	50
E-freight friendliness index:	50.0-2.0	24	4.17	20
Air liberalisation index:	50.0-2.0	24	4.17	15
Logistics Performance index:	4.2-1.95	3.1	32.26	10
Air Trade Facilitation index:	100.0-6.0	47	2.13	5

Source: Leitch (2020).

Thus, to calculate a composite AACM Index, the five component scores would be multiplied by the appropriate balancing factor and then by the assigned weighting. However, to research or derive data for such a composite model was beyond the scope of this study, leaving the development of the proposed composite AACM open to further research. The secondary objective of this study was construction of an Africa-specific connectivity model. As an initial test of the viability of the proposed model, this study limited itself to the consideration of the impact of using only the Air Connectivity Index (ACI) as the ACI is an already proven and widely accepted model with readily available data. It then used the ACI as a metric for air connectivity improvements for an Ethiopian case study.

For ease of reference and to position the AACM, it is worth briefly reiterating the step-by-step methodology for the proposed AACM. By applying this study's findings to the AACM, an improvement in connectivity may be associated with trade and tourism growth. This has two benefits: first, it enabled the research findings to be used as key inputs to the gravity model; second, it enabled the relevance of the research findings to be confirmed. The benefits of the application of the findings to the improvement in connectivity were quantifiable by the proposed AACM, and this, in turn, enables a simple cost-benefit analysis to be performed. This cost-benefit analysis may then be used as the basis for decisions by policymakers for the allocation of limited resources to gain an increase in connectivity. These interventions to remediate the identified challenges can be done on a project management basis.

The articulation of air connectivity measures with the Gravity Model of Trade was a key step in the further development of the conceptual model which enabled the study to relate increased connectivity to a reduction of the 'friction of distance', and thus improved access for tourists. By enabling places to become better connected, the perceived difficulty of 'getting there' is reduced and this enables a tourist destination to more fully exploit its competitive advantage. By developing its competitive advantage, it is evident that tourist destinations will become more successful, leading to economic growth. This, in turn, increases the frequency and number of flights and reduces the cost of air tickets to that place, creating more growth and a virtuous cycle. It may also be noted that the current limitations of the African airline industry give rise to an opportunity cost in terms of lost economic growth. This study did not attempt quantification of this opportunity cost as quality current data is difficult to obtain. However, it presents a significant opportunity for further research.

Testing the conceptual model: Ethiopian connectivity case study

To test the proposed AACM, this study considered the relationship between air transport connectivity and trade and tourism growth (using GDP as a broad proxy) in Ethiopia. The study compared GDP data over a ten-year period with the same period's connectivity scores. As noted by Shepherd (2018) in discussion with this researcher, due to the methodological differences in the construction of the various indices, for the limited application needed by this study it was decided not to attempt to weight and aggregate the indices. This limited the pilot test of the AACM to just the ACI as the measure of air connectivity. This is considered reasonable as it is a broad-based catch-all metric that accurately represented and thus quantified the role of air connectivity. Aggregating and possibly weighting the indices as proposed for the purposes of developing the more synoptic AACM is left open for further research.

Ethiopia has been an extraordinary success story in terms of demonstrating the benefits of improved air connectivity in Africa. Comprehensive ACI data (expressed as a percentage of maximum possible connectivity) was obtained for the Ethiopian test case from Arvis and Shepherd (2011: 45) and communication with Shepherd in August 2018 (Shepherd, 2018). GDP figures in US dollars were obtained from the World Bank (2018) website for the beginning and end of the ten-year period from 2007 to 2016 inclusive. This was then converted to the Ethiopian birr currency using mid-market figures from the Xe.com website. Using GDP in US$ and in the birr (ETB) provided two multipliers.

Table 3: Ethiopian ACI connectivity vs GDP Growth

Ethiopia	2007	2016	% change	Multiplier
ACI	2.22%	3.47%	156	-
GDP (US$)	19.7	73.1	371	2.37
fx	9.3	22.45	-	-
GDP (ETB)	183.2	1641.1	896	5.73

Source: Leitch (2020)

To develop a cost-benefit analysis, the next step was to quantify the cost of the 156% improvement in the ACI. This provided a Return on Investment multiplier. Research to determine the Capex on-ground infrastructure and airline capacity improvement indicated that the costs incurred by Ethiopia in improving connectivity by 150% were of the order of US$5 billion. This was made up of the cost of new aircraft added between 2007 and 2016 to the Ethiopian Airlines' fleet, improvements to Addis Ababa's Bole Airport, and investment in the large new freight handling facility at Bole. The investment in air traffic management was also considered. All CAPEX was considered as a single cost cash flow item, that is, without depreciation or over time through lease payments on aircraft. This could be considered expense inflating, however, the additional connectivity provided by the other 20 airlines using Bole airport was not factored in. That this is a rough quantification of the cost of providing the ACI improvement is acknowledged, but it is suggested that this simple cost accounting may form the basis of a more rigorous accounting cost/benefit analysis to be conducted by an institution with the resources to enable such an extensive data gathering exercise. The key data for the cost of the ACI change for Ethiopia is shown in Table 4 below:

Table 4: Cost of Ethiopia's improved connectivity, 2007–2016 in US$

Upgrade to Bole Airport	$1,000
Upgrade to Cargo Terminal	$ 250
Ethiopian Airline fleet	$3,500
Air traffic management	$ 25
Roads to airport	$ 10
TOTAL	$4, 785

Source: Leitch (2020)

The key finding was that, in US dollar terms, a U$4.8 billion investment in improved air transport connectivity may be related to a 150% improvement in connectivity. To the extent that this improvement in connectivity may be associated with an increase in GDP, there was a 371% increase in GDP, from U$20 billion to U$73 billion. This was an increase from once-off capital expenditure, whereas the benefits of the investment in connectivity infrastructure are ongoing.

When the benefits were measured in the local currency, the results were even more impressive: the U$4.8 billion investment in air connectivity may be associated with a 8.96% increase in GDP, providing an approximate six times multiplier on the U$ 4.8 billion investment. Although inconsistent, the RoI numerator was kept in dollars due to the difficulties of converting the amount incurred over the 9-year period to an equivalent birr amount, given the fluctuations in the exchange rate in that time period.

Case study considerations

It will be appreciated that comprehensively assessing the benefits of improved connectivity is not this simple. Given that the supply-side benefits of connectivity come through promoting international tourism and inward investment, any impact is likely to manifest gradually over time. Also, a protracted improvement makes it difficult to isolate the specific contribution improved connectivity makes to long-term economic growth, as distinct from the many other factors that drive GDP.

Implications and conclusion

The implications of this study in terms of policy development and implementation by industry practitioners are as follows: African airline industry policymakers and airline board directors may use the list of prioritised findings to motivate project-based interventions and investment to remediate these challenges. The study's proposed model, the AACM, may enable policymakers to perform cost benefit analyses to prioritise the investment in connectivity improvement to their own country's conditions. The implications of this research on tourism to and within Africa may be described in terms of both policy development and implementation by industry practitioners. In terms of policy, African air transport policymakers may use the proposed model to motivate project-based interventions and investment to remediate the identified challenges. Further, the study's proposed model may enable policymakers to perform cost-benefit analyses to prioritise the investment in connectivity improvement to their own country's conditions.

The global airline industry faces many challenges associated with high fixed costs, cyclical demand, intense competition and vulnerability to external shocks, all exacerbated by the Covid-19 pandemic. However, the African air transport industry faces even more challenges in addition to these factors, such as high input costs; poor safety; government interference; corruption; low productivity and overstaffing, amongst many others. These are all limitations to airline connectivity and thus tourism development. This study, therefore, proposed the AACM conceptual model to quantify and prioritise the effects of increased investment in remediating connectivity. It is proposed that by using improvement in connectivity as a proxy for reduced distance in the gravity model of trade, a place or a producer's ability to compete in the tourism market is improved. This enables places to utilise their improved competitive advantage to gain the edge over other places around the world, through reduced air ticket prices and greater frequency of flights. The study's test case of the benefits of increased connectivity in Ethiopia as measured by changes in the ACI and GDP growth, enabled a cost-benefit analysis to be performed on the cost of improving connectivity and the associated increase in GDP. Quantifying the benefits of a connectivity improvement may serve to motivate a project management approach to connectivity challenge remediation based on informed decisions taken by policymakers on how and where best to invest limited resources in connectivity improvements. This study advanced the application of the concepts of air transport connectivity, especially for application to Africa. It did so by proposing a model for the cost-benefit analysis of investment into the air connectivity that is key to developing tourism.

It is recommended that in order to improve the capacity of the African air transport industry to meet the demand for air transport to support economic growth, a plan of action should be developed for African airline industry policymakers to address the key challenges faced by the broader African air transport industry. The study recommends that policymakers and programme managers should commission a data gathering exercise to determine the key connectivity metrics associated with the most important challenges. Using this study's proposed synoptic of AACM, research may be undertaken to determine the costs and benefits associated with the implementation of a remediation strategy for their identified challenges. Using the AACM, a return on investment may be calculated to justify the investment in improved connectivity and thus to make funding and resources available. From the results of the cost-benefit analysis, funding and skills should be sought to operationalise projects to address their specific challenges. Using a project management approach, remediation strategies to address the challenges should be implemented and the progress and results monitored. In addition to improving connectivity, this will have the added benefit of serving to stress test or validate the model proposed by this study.

The key limitation of this study was the lack of resources to gather data to inform the specific connectivity models proposed for inclusion in the study's proposed synoptic African air transport connectivity model. Thus, more recent World Bank trade data and SRS Analyser data may be extracted to expand the Ethiopian case study across other challenges – particularly the challenge of liberalisation, which was identified in the base study as the key priority – and across other African countries.

In the course of this study, a number of avenues for possible future research were identified. Three key opportunities for further research are: to derive a measure of the opportunity cost of not investing in improved air transport connectivity. Using this study's proposed conceptual model, it is expected to be straightforward to form an assessment of this opportunity cost based on the multiple of economic growth derived from the associated increase in air connectivity, or a specific aspect thereof. From obtaining more recent World Bank trade data and SRS Analyser data, to expand the Ethiopian case study across other challenges – particularly the challenge identified in the case study as the key priority, namely Liberalisation – and across other countries. Lastly, to develop an integrated model combining the key metrics of extant models into two models: a synoptic model for Intra-African air connectivity, and one for Extra-African air connectivity.

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