African Journal of Hospitality, Tourism and Leisure. ISSN: 2223-814X

August 2021, Vol 10, No 4, pp. 1200-1214

Relationship between Air Passenger Transport, Tourism and Real Gross Domestic Product in Africa: A Longitudinal mediation analysis

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How to cite this article: Chakamera, C. & Pisa, N. (2021). Relationship between Air Passenger Transport, Tourism and Real Gross Domestic Product in Africa: A Longitudinal mediation analysis'. African Journal of Hospitality, Tourism and Leisure, 10(4):1200-1214. DOI: **https://doi.org/10.46222/ajhtl.19770720-157**

Abstract

This paper analysed the relationships between air passenger transport, tourism and real gross domestic product per capita (rGDPpc) in Africa. Mediation models were analysed using the structural equation modelling approach. This analysis determined the role of a mediator variable in the relationship between dependent and independent variables. Bi-directional positive relationships were found between air passenger transport and rGDPpc, tourism and rGDPpc, followed by air passenger transport and tourism. A certain proportion of air passenger transport's total effect on rGDPpc was from increased tourism, and some of the rGDPpc's total effect on air passenger transport were from increased tourism. A sizable effect of tourism on rGDPpc was derived from increased air passenger transport, and a larger portion of rGDPpc's total effect on tourism was from increased air passenger transport. These percentages show the strength of the mediation (or indirect) paths. The findings imply that it is vital to consider harmonised or integrated policies that facilitate the linkages between air passenger transport, tourism and rGDPpc. Novel in this study, is the scrutiny of the interrelationships between air passenger transport, tourism and rGDPpc in Africa, using longitudinal mediation analysis.

Keywords: Air passenger transport, Tourism, Gross domestic product, Mediation analysis

Introduction

Air transport and tourism have progressively been promoted in an attempt to stimulate economic growth in Africa (Abate, 2016; Bourguignon & Darpeix, 2016; Njoya & Nikitas, 2020; Tolcha, Bråthen & Holmgren, 2020). The Single African Air Transport Market (SAATM) initiative, which was launched in 2018, has become a flagship of the African Union Agenda 2063 to promote civil aviation liberalisation and economic growth. Among other benefits, advancing the aviation sector, promotes tourism and gross domestic product per capita (GDPpc). Empirical studies confirm that the economic contribution of air transport in Africa has been positive and is increasing (Nwaogbe, Wokili, Omoke & Asiegbu, 2013; Profillidis & Botzoris, 2015; Sackey & Yang, 2020; Saheed & Iluno, 2015;). Tolcha et al.'s (2020) findings show that the association between air transport and economic growth is country dependent; some countries, such as South Africa, Nigeria and Kenya, show causal associations from air transport to economic development, while Ethiopia shows causal associations from economic

development to air transport, yet Senegal and Angola show no causal relationships. The relationship between air transport and tourism in Africa is also reported in studies, such as Eric, Semeyutin and Hubbard (2020), Njoya (2013), and Pisa (2018). According to Njoya (2013), in the absence of an efficient aviation system, it is nearly impossible for many landlocked economies to develop and sustain tourism. Other scholarly literature (Phiri, 2016; Rasool, Maqbool & Tarique, 2021) have shown that tourism and economic growth can contribute to each other. The various observations from the literature, suggest a mutual association between air transport, tourism and GDPpc /or economic growth.

However, the main problem that was also highlighted in other studies (Nyasha, Odhiambo & Asongu, 2020; Phiri, 2016) is the lack of literature in the context of Africa. Moreover, previous studies have focused more on the relationship between any of the two variables (air transport versus GDPpc, tourism versus GDPpc, or air transport versus tourism). It is crucial to simultaneously analyse the depth of the interrelationship between air transport, tourism and GDPpc, which became the primary inspiration for this study. Simultaneous analysis of the three variables provides policymakers with the bases for the harmonisation of aviation, tourism and economic policies. Because of the close mutual relationship between air transport, tourism and GDPpc, policymakers should consider integrated strategies (Madurapperuma & Higgoda, 2020), to be more effective and beneficial to the economic welfare of a country. Likewise, collaboration programmes between the organisations in the air transport and tourism sectors can be promoted. This can facilitate airline stopovers in certain places with tourist attractions, known as 'stopover tourism' (Cristina, 2017). Examples of these collaboration programmes are the Singapore Stopover Holiday (with a night hotel stay and admission to more than 15 tourist attractions) and the Portugal Stopover (with 1-3 nights, exclusive hotel offers) (Tigu & Stoenescu, 2017). In this case, air transport and tourism should contribute effectively to income per capita.

Given this background, this study simultaneously analysed the interrelations between air passenger transport (AIR), tourism (TRSM) and real GDPpc (rGDPpc) in Africa, using longitudinal mediation analysis. Panel data for 24 African countries, from 1995 to 2019, were analysed using structural equation modelling (SEM). The use of SEM to analyse the interconnection between AIR, TRSM and rGDPpc is novel in this paper. To the best of our knowledge, this is the first paper to consider both (i) the mediation role of TRSM in the nexus between AIR and rGDPpc and (ii) the mediation role of AIR in the nexus between TRSM and rGDPpc, in the context of African countries. Moreover, our mediation analysis, accounted for the feedback effects between AIR and rGDPpc, as well as TRSM and rGDPpc. Besides the direct effects, this study ascertained the following: (i) proportion of AIR's total effect on rGDPpc that occurs through TRSM, (ii) proportion of rGDPpc's total effect on AIR that occurs through TRSM, (iii) proportion of TRSM's total effect on rGDPpc that occurs through AIR, and (iv) proportion of rGDPpc's total effect on TRSM that occurs through AIR. These proportions measure the mediation role of the mediator or the strength of the mediation (indirect) path.

Literature review

Air transport and economic growth or gross domestic product

It is commonly viewed that the growth in air passenger transport contributes to the gross domestic product. Some studies that have been conducted concerning the relationship between air transport and economic growth in Africa. Profillidis and Botzoris (2015) found strong positive correlations between air passenger transport and GDPpc, using data for many regions (sub-Saharan Africa, Middle East and North Africa, North America, Latin America and Caribbean, South Asia and Europe) and the world at large. Using vector error correction and

vector autoregression models, Tolcha et al. (2020) found a causality running from economic development to the demand for air transport in Kenya, South Africa and Nigeria. However, it was air transport demand, which was causing economic development in Ethiopia, while no causality was established in Angola and Senegal. Thus, the findings varied across the investigated countries, implying context-specific causal associations. Factors, such as the existence of domestic-based air carriers, varied income per capita and relative locational advantages, were believed to have contributed to the different findings.

Among the most recent findings, Sackey and Yang (2020) concluded that the air transport industry of Ghana contributed significantly to the country's economic growth. The industry creates jobs in areas, such as airline ticketing, air passenger carriers, air freight carriers and other aviation undertakings. In Nigeria, Saheed and Iluno's (2015) analysis revealed that air transport and economic growth are co-integrated and exhibit a causal effect from air transport and economic growth. These results were from various techniques used, which were the error correction model and Granger causality, co-integration, as well as the dynamic ordinary regression. Nwaogbe et al. (2013) confirmed that the Nigerian air transport industry supports the country's GDP, contributing billions to the economy and supporting over 61000 jobs. Bourguignon and Darpeix (2016) applied the co-integration technique and the error correction model to study the air traffic economic growth nexus in developing countries, which included African countries. The elasticities of GDP with respect to air traffic, were found to be inferior (in most cases, the elasticities were not statistically different from zero, yet not significantly different from one (1) either). Most importantly, the authors could not detect differences among developing regions, neither did they find any between developing and developed economies. Ishutkina and Hansman (2009) examined factors that promoted and hindered air transport development from a worldwide perspective. Among the factors that influenced the air transport demand, they found economic turndown, and political and economic sanctions to have an effect. Delaying the liberation of the African Aviation sector is still regarded a constraint to improved performance. Mhlanga and Steyn (2018) stated southern African states still contest liberalisation as they claim to protect their sovereignty, however, failing to compete in a liberalised environment is associated with economic costs that exceed the political costs.

Similar studies were conducted in many other non-African countries. Most of these studies (Aprigliano Fernandes, Pacheco, Fernandes, Cabo, Ventura & Caixeta, 2021; Balsalobre-Lorente, Driha, Bekun & Adedoyin, 2021 (Spain); Chi & Baek, 2013 (United States); Da Silva, Fernandes, Pacheco & Pires, 2018 (Brazil); Hakim & Merkert, 2016 (South Asia); Higgoda & Madurapperuma, 2020 (Sri Lanka); Hu, Xiao, Deng, Xiao & Wang, 2015 (China); Raheja & Zhong, 2018 (Singapore)) confirmed the existence of a relationship between air passenger transport and economic growth. Overall, most studies tend to have used causality techniques. Context has been shown to be an important determinant of causality (whether uni-directional or bi-directional) between countries, and time horizon (long-run or short causality) (Hakim & Merkert, 2016; Higgoda & Madurapperuma, 2020; Raheja & Zhong, 2018). In Brazil, Da Silva et al. (2018) found that causality differed between domestic and international air traffic. A bi-directional causal relationship could be explained by the fact that high economic activity and development stimulate air travel demand, while air connectivity and travel promote access to the market, ideas, people and capital (Tolcha et al., 2020), which are vital for development. Uni-directional causality shows absence of a feedback effect either from air transport to growth or from growth to air transport.

Tourism and economic growth or gross domestic product

Although there are a limited number of studies investigating the nexus between tourism and economic growth from an African perspective, an interesting effort has been made. Rasool et al.'s (2021) causality tests suggest a two-way causal relationship exists between tourism (inbound) and economic growth in the BRICS (Brazil, Russia, India, China and South Africa) economies. Moreover, their ARDL revealed a co-integrating relationship in the long run. In particular, a percentage increase in inbound tourism resulted in a 0.31% rise in domestic real output. A tourism-led growth hypothesis was also demonstrated by Azeez (2019), who assessed the nexus between GDP and tourism receipts in North Africa, using the Pooled Mean Group (PMG) technique. It was demonstrated that tourism stimulates economic growth in the long-run and short-run.

Focussing on South Africa, Phiri's (2016) non-linear approach suggests a two-way causality between tourist receipts and economic growth, however, no causality was found when the tourist arrivals variable was used. Moreover, the linear approach confirmed that tourist receipts drive economic growth. However, a one-way causality was found from economic growth to tourist arrivals. These findings are in support of the tourism-driven growth hypothesis, which was also confirmed in earlier studies, such as Fayissa, Nsiah and Tadasse (2008). Tourism receipts were found to cause increased levels of GDP and economic growth in 42 African countries (Fayissa et al., 2008). Makochekanwa (2013) scrutinised the economic role of tourism in the SADC states. His findings revealed that tourism increases per capita GDP by 0.16%. In Zimbabwe, Musavengane (2018) analysed approaches for pro-poor tourism development with the aim of improving local economic development. He established the need for Zimbabwe to have a better tourism governance processes and systems that can facilitate effective realisation of pro-poor local economic development objectives. The role of tourism in South African local economic development (King Sabata Dalindyebo Local Municipality) was demonstrated in Dlomo and Rogerson's (2021) article. Lekgau and Tichaawa (2020) demonstrated the contributions of wildlife tourism economic development and employment in Botswana. An empirical investigation of the tourism – economic growth relationship was conducted in many other non-African countries. Among these studies, Manzoor, Wei and Asif (2019) demonstrated the significant contribution of tourism to economic growth in Pakistan. An association between the variables was found in the long run. Based on the Organisation for Economic Co-operation and Development (OECD) countries, Govdeli and Direkci's (2017) results showed a positive effect of tourism revenue on economic growth in the long run. Likewise, Ohlan (2017) found evidence of long-run and short-run positive effects of tourism on India's economic growth.

Among other explanations for the economic growth contribution of tourism, this sector creates employment and generates revenue (Manzoor et al., 2019). Causality from economic growth to tourism is often anticipated in Africa, as the respective countries use their income to enhance tourism sites and infrastructure in an attempt to win tourists to their destinations (Phiri, 2016). At the same time, a bilateral causal relationship is logical, as tourism revenue and employment spur GDP/income per capita, which in turn is used to improve the tourism infrastructure. Unfortunately, there is insufficient empirical evidence regarding the association between air transport and tourism in Africa, as also mentioned by Makochekanwa (2013). This paper attempts to narrow this knowledge gap.

Air transport and tourism

There is insufficient empirical evidence regarding the association between air transport and tourism in Africa. Eric et al. (2020) investigated the contribution of air connectivity to the tourism sector in Kenya. Their analysis confirmed the vital role of air transport in the country's

tourism sector and highlighted the role of the regulatory air transport environment in stimulating demand for tourism. The nexus between air transport and tourism in African economies was also examined by Njoya (2013). He indicated that an open skies policy could assume a major role in reinforcing the interconnection between air transport and the tourism sector. Many similar studies were conducted in other regions, for instance, Ozer Balli, Balli and Tsui (2019) showed that in New Zealand, the tourism partners' airline seats are an important factor that influence a demand for tourism. The exceptions are the richer countries, such as Japan and the USA. In Romania, among the conclusions of Cristina (2017) is that air transport is a vital component of tourism. Moreover, a robust association exists between air travel and the destination's development, accounting for regional economic development and tourism development. Zajac (2016) also reported that some factors in the structure of tourism, together with visa requirements and tourist attacks, are among the factors that hinder the development of air transport in Europe. The literature shows that very few studies have examined the interconnection between air transport, tourism and GDP. Pisa (2018) studied the linkage between air transport, tourism and growth in South Africa using Granger causality and the vector auto-regressive model (VAR). A probable association between tourism and GDP were found; the study concluded that no further analysis of the nexus between air transport and GDP could be conducted, since these two variables were stationary at different levels. Based on co-integration and Granger causality analyses, Madurapperuma and Higgoda's (2020) findings suggest there is a stable one-way short run connection from air transport to economic growth in Sri Lanka. On the other hand, they report a short run two-way causality between tourism and air transport. This study advances the knowledge of the relationship that subsists between air passenger transport, tourism and GDP per capita.

Methods and data

Data

This study used data for (i) air transport passengers (number carried), (ii) international tourism (number of arrivals) and (iii) GDP per capita (at constant 2010 USD). The source of the data was the World Bank's 2020 World Development Indicators (WDI) database. Based on data availability, this study used data of 24 countries, from 1995 to 2019. The investigated countries were namely: Algeria, Angola, Botswana, Burkina Faso, Cabo Verde, Egypt, Ghana, Kenya, Madagascar, Malawi, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Seychelles, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia and Zimbabwe. Few missing observations for Togo and Ghana were addressed through interpolation in EViews.

Models

We analysed multiple models that sought to determine the interrelationship between AIR, TRSM and rGDPpc. It is plausible, as shown in the literature review, that there could be possible feedback effects between the variables, which is accounted for in this paper. Figure 1 assumes that a portion of AIR's total effect on rGDPpc occurs through TRSM, the mediator. In Figure 2, it is AIR that plays the mediation role. In each of the four models, Paths B and C represent the mediation path, which reveals a certain percentage of the explanatory variable's effect on the dependent variable. This is the indirect effect of the explanatory variable, calculated as Path B x Path C. Path A in each model, is the direct path, which shows the direct effect of the explanatory variable on the dependent variable. Thus, the models allow us to ascertain both the direct and indirect effects of AIR on rGDPpc (model 1), rGDPpc on AIR (model 2), TRSM on rGDPpc (model 3) and rGDPpc on TRSM (model 4). We can determine if mediation exists in each case, and the size of the mediation. Due to possible reverse or feedback effects from rGDPpc to AIR and TRSM, models 2 and 4 test for these possibilities.

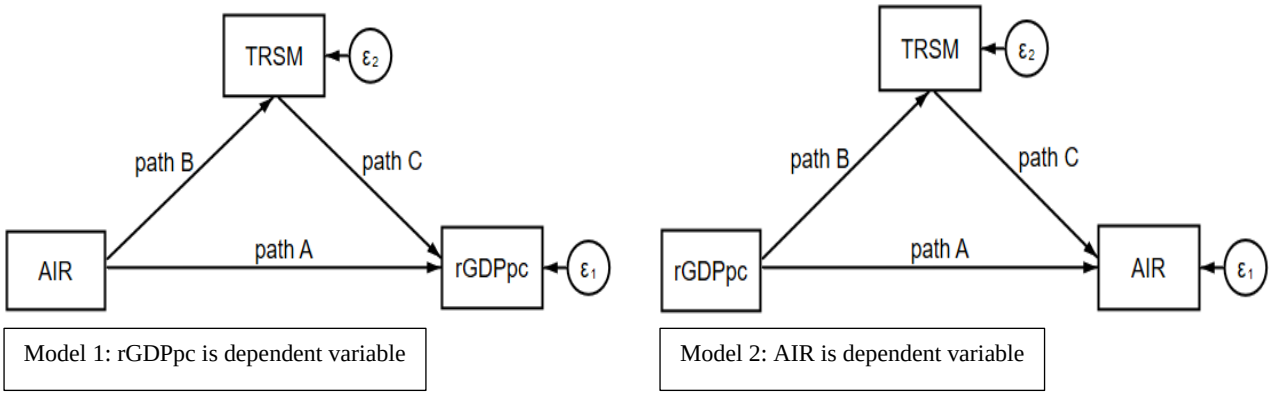

Figure 1: Mediation effect of TRSM in the nexus between AIR and rGDPpc

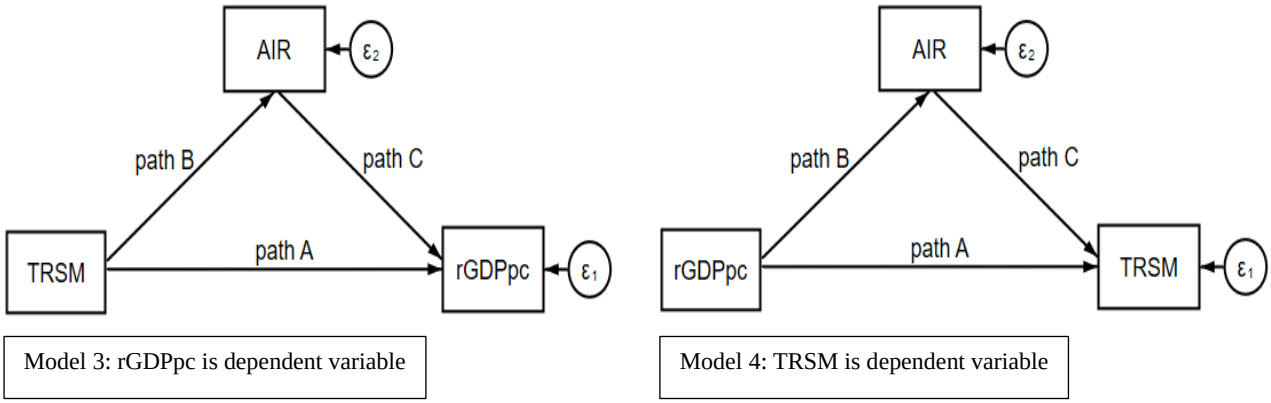

Figure 2: Mediation effect of AIR in the nexus between TRSM and rGDPpc

Estimation technique

While Baron and Kenny's (1986) method is often used for mediation analysis, this study applied the structural equation modelling (SEM) approach to estimate the complex relationships that are hypothesised in Figures 1 and 2. In SEM, the maximum likelihood method is considered to estimate the parameters. SEM was appropriate to achieve the objectives of this study for the following reasons; first, longitudinal mediation analysis can be computed; second, the direct and indirect effects of the explanatory variables were estimated, thus, the total effect was separated; third, many potential relationships among variables can simultaneously be estimated using SEM. In this study, it allowed for the simultaneous estimation of possible relationships between AIR, TRSM and rGDPpc. The following criteria were used to check for the fitness of the estimated models: (i) the root mean square error of approximation (RMSEA), (ii) the Tucker-Lewis fit index (TLI), (iii) the comparative fit index (CFI), and (iv) standardised root mean residual (SRMR). The standard or ideal model should satisfy RMSEA < 0.08, TLI > 0.90, CFI > 0.90, and SRMR < 0.05 (Wang, Li, Bai, Cui, Yang, Mu & Yang, 2021).

Results and discussion

Preliminary data analyses

This section provides the summary statistics and correlation coefficients. Table 1 shows the descriptive statistics of the variables. The 24 countries reported an annual average rGDPpc of US$2773, 1.9 million air passengers and about 2 million inbound tourists over the period of 1995-2019. Malawi recorded the lowest number of AIR (5856) in 2013, while the largest

number (25 650 178) was recorded by South Africa in 2019. As for TRSM, the lowest number of arrivals (9000) was reported by Angola in 1995, whereas the highest numbers were recorded by Egypt (14,1 million) in 2010. Mozambique had the lowest rGDPpc (US$2016) in 1995. Seychelles reported the largest rGDPpc (US$15049) in 2019. The high values of standard deviations show that the values tend to be far from the mean.

Table 1: Descriptive statistics

Variable	Units	Obs	Mean	Std. Dev.	Min	Max
AIR	Number carried	597	1872971	3376584	5856	25650178
TRSM	number of arrivals	590	1967189	2737880	9000	14051000
rGDPpc	Constant US$	600	2783,934	2772,86	215,5476	15048,75

Note: Obs – observations, Std. Dev – standard deviation, Min – minimum, and Max - maximum. US$ -United State Dollars.

Correlation tests are part of the initial analysis and the findings are shown in Table 2. The positive correlation coefficients suggest a linear association between each pair of variables, which is very high between AIR and TSRM. However, rGDPpc is weakly correlated with AIR and TRSM. All coefficients are statistically significant at the 1% significance level. Positive correlations imply that two variables tend to move in the same direction. The correlation coefficients support our expectation that the three variables (AIR, TRSM, rGDPpc) have a positive effect on each other. Nonetheless, more robust analysis is required to have a deeper understanding of the nexus between AIR, TRSM and rGDPpc. This study uses the SEM technique for further analysis. Panel unit root tests are computed prior to the SEM to determine the stationarity properties of the variables.

Table 2: Correlation Matrix

	AIR	TRSM	rGDPpc
AIR	1		
TRSM	0,7973***	1	
rGDPpc	0,3645***	0,3411***	1

Note: All variables in logs. *** denotes significant at the 1% ($p < 0.01$) significance level.

Table 3 presents the unit root results based on the Levin, Lin & Chu (LLC) test and the augmented Dickey-Fuller (ADF) - Fisher Chi-square (ADF) test. Given the panels, the LLC test assumes a common unit root process. This homogeneity assumption is a weakness of this approach, since panels may not follow a common unit root process. The ADF approach addresses this weakness by assuming an individual unit process. Despite this major difference between the LLC and ADF tests, both show evidence that the levels of the variables are stationary. Working with stationary variables is essential to avoid spurious results.

Table 3: Stationarity tests

Method	Levin, Lin & Chu		ADF-Fisher Chi-square	
	Level	Difference	Level	Difference
Variable	Coefficient	Coefficient	Coefficient	Coefficient
AIR	-1,4799*	-18,8732***	-1,4799*	328,4900***
TRSM	-6,1199***	-19,0395***	79,9812***	335,4900***
rGDPpc	-4,8360***	-6,5150***	61,9928*	182,0990***

Note: All variables in logs. Automatic lag selection based on the Schwarz Information Criterion. Intercept is included. ***, **, * denote significant at the 1% ($p < 0.01$), 5% ($p < 0.05$) and 10% ($p < 0.1$) significance levels.

Presentation and discussion of results: structural equation modelling

Mediation role of TRSM in the nexus between AIR and rGDPpc

Based on the diagnostic tests, the model fit criteria (RMSEA, CFI, TLI and SRMR) meet the standards across all models as shown in Tables 4 and 5. Thus, the estimated models are adequate. Estimating Models 1 and 2 in Figure 1, generates results that are displayed in Table 4, with TRSM being the mediator. While ascertaining whether or not mediation exists and the degree thereof, it is plausible to first discuss the direct effects (Paths A, B & C).

Table 4: Air passenger transport and real GDPpc nexus: Tourism as a mediator

	Model 1		**Model 2**	
	Direction	Coefficient	Direction	Coefficient
Direct effect (DE)				
Path A	AIR → rGDPpc	0,2465***	rGDPpc → AIR	0,4552***
		(0,0286)		(0,0528)
Path B	AIR → TRSM	0,5479***	rGDPpc → TRSM	0,5070***
		(0,0292)		(0,0556)
Path C	TRSM → rGDPpc	0,0760**	TRSM → AIR	0,5733***
		(0,0320)		(0,0367)
Indirect effect (ID)				
Path B x Path C	AIR → rGDPpc	0,0417**	rGDPpc → AIR	0,2907***
		(0,0177)		(0,0369)
Total effect				
DE + ID	AIR → rGDPpc	0,2882***	rGDPpc → AIR	0,7459***
		(0,0227)		(0,0588)
Diagnostic Tests				
Model fit criteria (standard)	*Fitted value (FV)*	*Decision*	*Fitted value (FV)*	*Decision*
RMSEA (FV < 0,05)	0,000	Accept	0,000	Accept
CFI (FV > 0,90)	1,000	Accept	1,000	Accept
TLI (FV > 0,90)	1,000	Accept	1,000	Accept
SRMR (FV < 0,05)	0,000	Accept	0,000	Accept

Notes: ***, ** denote significant at the 1% ($p < 0.01$) and 5% ($p < 0.05$) significance levels. Total effect is direct effect (Path A) plus indirect effect (Path B X Path C). Values in parenthesis ( ) below the coefficients are standard errors.

AIR to rGDPpc

In Model 1, all coefficients are positive and statistically significant. It shows that AIR contributes to rGDPpc (Path A) and to TRSM (Path B). At the same time, TRSM can promote rGDPpc (Path C). The elasticity coefficient of rGDPpc with respect to AIR, suggests that a 1% increase in air passenger transport increases rGDPpc by 0.25%. This result is in line with the findings of Saheed and Iluno (2015) in Nigeria, Tolcha et al. (2020) in South Africa, Nigeria and Kenya, among other studies. However, the result is in contradiction to Tolcha et al.'s (2020) findings in the case of Angola and Senegal. Our sample does not include Senegal but did include Angola. The positive contribution of AIR to rGDPpc is expected for a number of reasons. There have been improvements in airline connectivity in Africa, with Ethiopia becoming more connected, followed by South Africa and Kenya (Tolcha et al., 2020). Air transport can generate income and create employment, both directly (jobs and income linked to air transport operations), indirectly (jobs and income from air transport's supply chain) and induced (improved expenditure of direct and indirect workers) (Cristina, 2017; Cristureanu & Bobirca, 2007; Sackey & Yang, 2020). As a result, the demand for air passenger transport would stimulate economic activity and boost rGDPpc.

AIR to TRSM

The coefficient for the effect of AIR on TRSM indicates that a percentage rise in air passenger transport improves tourism by 0.55%. This finding supports Njoya's (2013) findings in African countries and Eric et al.'s (2020) in Kenya; both reported the importance of air transport to the tourism sector. Air traffic demand promotes the development of the air transport sector, which enables tourism development (Saheed & Iluno, 2015). In this case, the aviation policies that promote competition, such as the liberalisation of the air transport sector, become critical for the tourism industry. Njoya (2013) mentioned that the liberation of air transport encourages the growth of airlines that are cheaper, which further promotes tourist arrivals. The importance of the deregulation of the air transport sector, which leads to low-cost airlines and the influence on tourism, was also indicated by Cristina (2017).

TRSM to rGDPpc

The elasticity coefficient of rGDPpc, with respect to TRSM, indicates that a 1% increase in tourist arrivals could raise rGDPpc by approximately 0.08%. Therefore, tourism is a significant driving factor of output per capita. Our coefficient is much lower than that of Makochekanwa (2013) whose elasticity was 0.16% in the context of the Southern African Development Community (SADC). However, it could be due to the use of different tourism indicators; namely tourism receipts in contrast to tourist arrivals. Like the air transport sector, tourism contributes to rGDPpc by generating revenue and creating employment in a country. That revenue and employment would ultimately have an influence on rGDPpc. In this regard, Rasool et al. (2021) maintain that the foreign exchange earnings from inbound tourism positively influence the economic growth performance of the BRICS states. Inbound tourism is a vital export product that enables even the poor to gain by selling products and services to tourists, as argued by Makochekanwa (2013). Accordingly, the development of the tourism industry has the capacity to improve income per capita.

rGDPpc to AIR

There is a possibility for reverse effects among the variables in Model 1, as demonstrated in the literature. Consequently, we consider Model 2 to cater for the reverse effects from rGDPpc to AIR, rGDPpc to TRSM and TRSM to AIR. Model 2 still assumes TRSM as a mediator. In Model 2, a 1% increase in rGDPpc increases air passenger transport by 0.46%. Higher income per capita allows many people to afford air trips, for various purposes such as leisure and business. As mentioned by Bourguignon and Darpeix (2016), the volume of air transport relies on the country's economic activity level and the impact of the population. Comparing the significance of Path A in Model 1 and Path A in model 2, the findings imply a bi-directional relationship between AIR and rGDPpc. This two-way association is expected; also confirmed in the previous literature (for example, Da Silva et al., 2020).

rGDPpc to TRSM

Path B of Model 2 suggests that a percentage increase in rGDPpc leads to a 0.51% increase in international tourist arrivals. This suggests that African countries use their GDP or income to improve their tourism industry. While Model 1 shows that TRSM impacts rGDPpc, Model 2 confirms the reverse effect. Consequently, this suggests a bi-directional relationship between TRSM and rGDPpc. This confirms the results of Phiri (2016) in South Africa and Rasool et al. (2021) in the BRICS economies, and demonstrates the two-way causality between tourism and economic growth.

TRSM to AIR

Furthermore, the results show that a 1% increase in TRSM could raise AIR by 0.57% (Path C, Model 2). The bigger the number of tourist arrivals, the higher the demand for air transport. The development of tourist attraction centres may lead to the creation of new air transport routes or stopovers. Again, our results imply a two-way relationship between AIR and TRSM. The development of the tourism industry boosts the demand for air travel and necessitates the need to improve domestic airports, which in reverse, promotes tourism. Eric (2020) states that the robust complementarities between air transport and tourism in some regions, entail that the development of tourism relies on both government policy and market conditions in the air transport industry and vice versa. In view of the above relationships, the next subsections discuss the mediation role of TRSM in the two-way relationship between AIR and rGDPpc.

How TRSM mediates the effects of AIR on rGDPpc?

In Model 1, the direct effect of AIR on rGDPpc is 0.25% (Path A). However, this is not the total effect. Some of AIR's effect on rGDPpc travels through the mediator, TRSM. Paths B x C represent the mediation path that occurs through TRSM, which is the indirect effect of AIR on rGDPpc through TRSM. This indirect effect, which is calculated as Path B x Path C is equivalent to 0.04%. The total effect of AIR on rGDPpc is 0.29%. It is clear that the indirect effect (mediation path) explains a smaller portion (14.5%) of the total effect; the remaining 85.5% is a direct effect. Nevertheless, this effect is statistically significant and it supports the complementarity between the aviation and tourism sectors, which is vital to the income per capita contribution.

How TRSM mediates the effects of rGDPpc on AIR?

Our results show that 0.75% is the total effect of rGDPpc on AIR, which can be divided into a direct and indirect effect. The direct effect of rGDPpc on AIR is 0.46% as shown in Model 2. The indirect effect of rGDPpc on AIR through TRSM is 0.29%. Consequently, the direct effect explains 61% of the total effect, whereas the indirect effect explains 39% of the total effect. The mediation path and its proportion, shows that tourism plays a critical enabling effect of income per capita on the air transport industry. While rGDPpc can contribute directly to AIR, it could facilitate the development of the tourism industry, which in turn increases air traffic demand.

Mediation role of AIR in the nexus between TRSM and rGDPpc

The findings from the estimation of Models 3 and 4 in Figure 2 are shown in Table 5. Unlike the first two models, the primary relationship is between TRSM and rGDPpc, with AIR assuming the mediation role. However, it is still about the underlying relationship between AIR, TRSM and rGDPpc. All the coefficients are positive and statistically significant. Models 3 and 4 are also suggesting bi-directional relationships between (i) TRSM and rGDPpc, (ii) TRSM and AIR, and (iii) AIR and rGDPpc. The discussion of these relationships was already given in Section 4.2.1. The next subsections discuss the mediation role of AIR in the two-way relationship between TRSM and rGDPpc.

How AIR mediates the effects of TRSM on rGDPpc?

Model 3 shows that the direct effect of TRSM on rGDPpc is 0.08% and the indirect effect is 0.17%. The total effect is 0.25%. Unlike Model 1 and 2, the indirect effect (mediation path) explains 68% of the total effect, while the remaining 32% is a direct effect. The strength of the mediation path suggests that TRSM in Africa is overdependent on AIR for its total contribution to rGDPpc. This is plausible, especially that most international tourists use air transport.

Table 5: Air passenger transport and real GDPpc nexus: Tourism as a mediator

	Model 3		**Model 4**	
	Direction	Coefficient	Direction	Coefficient
Direct effect				
Path A	TRSM→ rGDPpc	0,0760**	rGDPpc→ TRSM	0,1253**
		(0,0320)		(0,0527)
Path B	TRSM→ AIR	0,6848***	rGDPpc→ AIR	0,7459***
		(0,0365)		(0,0588)
Path C	AIR→ rGDPpc	0,2465***	AIR→ TRSM	0,5118***
		(0,0286)		(0,0328)
Indirect effect				
Path B x Path C	TRSM→ rGDPpc	0,1688***	rGDPpc→ TRSM	0,3817***
		(0,0216)		(0,0388)
Total effect				
DE + IE	TRSM→ rGDPpc	0,2448***	rGDPpc→ TRSM	0,5070***
		(0,0268)		(0,0556)
Diagnostic tests				
Model fit criteria (standard)	*Fitted value (FV)*	*Decision*	*Fitted value (FV)*	*Decision*
RMSEA (FV < 0,05)	0,000	Accept	0,000	Accept
CFI (FV > 0,90)	1,000	Accept	1,000	Accept
TLI (FV > 0,90)	1,000	Accept	1,000	Accept
SRMR (FV < 0,05)	0,000	Accept	0,000	Accept

Notes: ***, ** denote significant at the 1% (p < 0.01) and 5% (p < 0.05) significance levels. Total effect is direct effect (Path A) plus indirect effect (Path B X Path C). Values in parenthesis ( ) below the coefficients are standard errors.

How AIR mediates the effects of rGDPpc on TRSM?

Based on Model 4, the findings reveal that the total effect of rGDPpc on TRSM is 0.51%, the direct effect is 0.13% and the indirect effect through AIR is 0.38%. Thus, 24.7% of the total effect of rGDPpc on TRSM is a direct effect, while the indirect effect explains a larger portion (75.3%) of the total effect. The mediation path is quite dominant, showing that the influence of rGDPpc on TRSM is extremely dependent on the AIR.

Implications and recommendations

Among the major implications that emerge from our findings is that a significant portion of AIR's effect on rGDPpc occurs through its effect on TRSM. The same applies when rGDPpc is used to promote AIR, while TRSM facilitates the effect of increased rGDPpc on AIR. Policymakers should regard TRSM as a crucial mediator in the effect of AIR on rGDPpc and vice versa. We recommend African countries to synchronise tourism, and aviation policies to optimise the economic growth contribution of these two sectors. The second major implication is that the effect of TRSM on rGDPpc in Africa is more dependent on AIR's performance. The direct effect of TRSM on rGDPpc is inferior (about 0.08%) compared to the indirect effect (about 0.19%) via increased air transport demand. This implies that African countries cannot expect to improve their economic welfare through tourism if the aviation industry struggles. It is recommended that the African governments should make the air transport sector more competitive, by improving service quality and drive down air-travel costs. One way to improve competition is the deregulation of the air transport sector. There is a need to promote collaboration between the organisations in the air transport and tourism industries, aiming at improving the experience of international tourists. Cristina (2017) talks about "stopover" initiatives implemented through partnerships of the organisations in the tourism and aviation sectors. These stopovers allow passengers to stop in certain attractive areas, enjoy those destinations for a few hours while in transit.

Moreover, while an increase in rGDPpc can have a significant direct influence on tourism performance, a larger portion of the total effect occurs indirectly through AIR. Therefore, the effect of rGDPpc on TRSM is dependent on AIR to a large extent. This implies that the economic development of African countries cannot effectively enhance the tourism sector without proper development of the aviation sector. We recommend that policymakers should channel increased rGDPpc towards the development of the tourism industry, concurrently with notable improvements in the air transport sector. In general, tourism, aviation and economic policy harmonisation is critical. A bi-directional relationship between each pair among AIR, TRSM and rGDPpc is special for policymaking. Economic policies can be used to promote both TRSM and AIR, which in reverse, will stimulate rGDPpc. At the same time, aviation policies to advance the African aviation sector (e.g., deregulation) can encourage TRSM and boost rGDPpc, which in turn promotes AIR. Similarly, the TRSM development promotes AIR and rGDPpc, which in reverse, will encourage TRSM. Policymakers are recommended to take advantage of the reciprocal positive effects between AIR, TRSM and rGDPpc to create sustainable economic welfare. However, the special bond between AIR, TRSM and rGDPpc also implies a major challenge, if at least one of these variables is adversely affected. The emergence of the COVID-19 and the accompanying containment measures, substantially affected the tourism and air transport industries. Real GDPpc is adversely affected, jeopardising economic welfare. We recommend that the intervention measures to revive the tourism and air transport industries should take cognisance of each other.

Conclusion

Despite the literature acknowledging the relationships that exist between air passenger transport, tourism and GDPpc, very few studies have analysed the associations between these three variables in the context of Africa. No study has attempted to analyse the interrelationships between these variables from a mediation analysis perspective. Inspired by these research gaps, the purpose of this paper was to analyse the relationships between AIR, TRSM and rGDPpc in Africa, based on the longitudinal mediation analysis. Annual data, from 1995 to 2019, for 24 African countries was used. The findings show a two-way significant relationship between AIR and rGDPpc, TRSM and rGDPpc, and AIR and TRSM. A special relationship exists in that all these variables positively influence each other. TRSM is a valid mediator in the relationship between AIR and rGDPpc. About 15% of AIR's total effect on rGDPpc occurs through increased TRSM, and about 39% of rGDPpc's total effect on AIR occurs though increased TRSM. Likewise, AIR is a valid mediator in the association between TRSM and rGDPpc. Approximately 69% of TRSM's total effect on rGDPpc occurs through increased AIR, and about 75% of rGDPpc's total effect on TRSM happens through increased AIR. Consequently, a proportion of TRMS's total effect that directly influences rGDPpc is smaller, compared to the indirect effect via AIR. Similarly, the fraction of rGDPpc's total effect that directly influences TRSM, is inferior compared to the indirect effect. It shows that developments in the air transport sector are extremely critical in the connection between TRSM and rGDPpc. The major conclusion is that a high level of complementarities exists between air transport and tourism industries. As such, harmonisation of policies is very important to safeguard the effective contributions of AIR and TRSM on rGDPpc. Africa should promote collaborations or partnerships between the organisations in the air transport and tourism industries.

We believe that the findings of this study and their implications are vital for the African countries to set air transport and tourism among the major components of the continent's growth trajectory. However, this study is limited by the fact that the countries are analysed as a panel and hence, no individual country's results are shown. Furthermore, a single mediator is considered in each estimated model and no additional control variables are included in the

models. Moreover, as highlighted by Eric (2020), it is also a limitation to only consider inbound tourism, since it restricts a deeper analysis of the welfare effect as outbound tourism is excluded. There are suggestions for future research. First, researchers should consider multiple mediators when analysing the relationships between AIR, TRSM and rGDPpc using SEM, which has the capacity to accommodate several mediators. Second, other control variables that are believed to have an effect on the dependent variables can be added in the models. Third, while we applied inbound tourism, future studies may account for outbound tourism. Fourth, instead of using international tourism arrivals, researchers can apply international tourism receipts.

Acknowledgements
The authors thank the University of Johannesburg (UJ) for financially supporting this research. We also thank the anonymous reviewers for their constructive comments.

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