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Causal Relationship between Air Transport, Tourism and Economic Growth: Joinpoint Regression and Granger Causality Analysis

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Abstract: The aim of this study is twofold: to describe the overtime changes in trends and to investigate the causal relationship between air transport, tourism and economic growth for South Africa between 1995 and 2015. Using an ecological design, Joinpoint regressions tailed at $p<0.05$ were computed for each variable to determine annual percentage changes. Causality and co-integration were inferred through the Granger causality and the Johansen co-integration tests. Additionally, a vector auto-regressive model (VAR) was computed to test for linear inter-dependencies among the variables. Significant increases were observed for all variables between 1995 and 2015. The results of the stationary tests showed that that air transport variables were stationary the first differences while the tourism variables and GDP variables were stationary at second difference. Cointegration tests can be applied on series that are stationary at the same level. Therefore no further inference was made on the relationship between air transport variables and GDP. Both the cointegration and causality tests did not provide evidence of causality and long run relationships between GDP and tourism variables. However, a proportion of the variance in tourism expenditure and tourism receipts was shown to be explained by GDP through the VAR model. The results imply potential associations between tourism and GDP in South Africa.

Keywords: causality; air transport; tourism; economic growth; South Africa

JEL Classification: L93; O40; C32

1. Introduction

The underlying cause or effect of economic growth on air transport and tourism is often debated, particularly in emerging and upcoming economies like South Africa. South Africa is characterised by strong investments growth particularly in air transportation and tourism infrastructure noted by aggressive marketing and advertising. (SABC News, 2017) South Africa's air transport infrastructure is ranked first in Africa (out of the 37 countries surveyed) according to the World Economic Forum (2017). In addition, South Africa is ranked 19th and 17th in visa openness and cost competitiveness respectively. (World Economic Forum, 2017; IATA, 2016)

Air transportation is one of the fundamental basis that drives and reflects the efficiency and growth of an economy. In business logistics air transport is a vital function in the domains of logistics systems and management such as just in time manufacturing. More importantly, economic growth has been shown to improve and/or associate with efficiencies in air transportation, and other aspects related to air logistics systems and management including supply chain management, planning, implementing, and controlling procedures for the efficient and effective transportation and storage of goods including airport services. (Jarach, 2001; Yuan et al., 2010) Air transport expedites tourism, exports and foreign direct investment. In 2014, 3.5% of South Africa's GDP was derived from tourists arriving by air and the air transport sector. (IATA, 2016)

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Therefore, this study aims to firstly illustrate and describe the overtime changes in trends in air transport, tourism and economic growth for South Africa between 1995 and 2015. Secondly, the paper will report and explore causal relationship between air transport, tourism and economic growth.

2. Literature Review

2.1. Air Transport and Economic Growth

Numerous studies have found evidence of causality between air transport and economic growth. (Baker et al., 2015; Button et al., 1999; Button & Yuan, 2013; Button et al., 2010; Marazz et al., 2010; Hakim & Merket, 2016) Air transport contributes to economic growth through four networks effects namely; primary, secondary, tertiary and perpetuity effects. (Button & Yuan, 2013) Primary effects are the first network and comprise employment creation and income generation in the construction of airports, runways and other facilities. (Button & Yuan, 2013) Secondary effects are generated from the operation of the airports. (Button et al., 2010) Job creation will arise in the operation of the airports in activities such as cargo handling and security among others. Tertiary effects are derived from the establishment of a regional airport in a specific geographical location. Regional airports, increase connectivity through the increase in the number of direct flights, thereby shortening journey times for passengers and enabling just in time deliveries for businesses. Perpetuity effects, the fourth effect arise when the spill-over effects from airport transform the structure of the regional economy. (Button et al., 1999) Examples cited include the transformation of regions such as Dulles (Washington) and Logan (Boston) into high technology regions owing to close proximity to airports. (Button et al., 1999) Air transport improves connectivity particularly in high growth markets creates better market access for goods and services. (IATA, 2016) Owing to short transit time and good security, at least a quarter of the value of goods traded worldwide is conveyed by air transport. Freight is conveyed either in all cargo aircraft or combination passenger – cargo aircrafts. As a result, a positive association is expected to exist between air passenger transport demand, air freight transport demand and the number of air carriers departing from a particular country.

2.2. Tourism and Economic Growth

Tourism is an important source of foreign currency that is necessary for a positive balance of payments and the generation of tax revenue to the host nation. (Balaguer & Cantavella, 2002) Tourism generates additional tax revenue for government through tourism-specific taxes such as airport tax, tariffs on imports of goods used in the sector and capital gains tax on assets owned by tourism institutions. (in the case of sale of assets) (Ashley & Mitchell, 2006) Tourists spend on goods and services such as accommodation, food, transport services as well as leisure activities thus creating jobs and generating income. (Kareem, 2008) In addition, tourism expenditure creates spill-over benefits to other sectors in the economy. (Krieshan, 2015) Vellas (2011) postulated that tourism impacts economic growth through direct, indirect, induced and socio-economic effects. These effects create additional demand for goods and services used in the tourism sector such as intermediate inputs. Furthermore, tourism through the multiplier effects, generates higher wages for workers in the associated sectors. Investment in the tourism sector particularly, in infrastructure such as roads, hotels and banks has been shown to improve economic activity. (Nene & Taivan, 2017) Tourism contributes to poverty reduction as it creates both seasonal and permanent jobs for unskilled workers. (Ashley & Mitchell, 2006) In addition, tourism assists with redistribution of wealth from tourists to residents of the host country. (Croes & Vanegas, 2008)

Numerous studies exist on the causal relationship between tourism and economic growth, as well as the causal relationship between air transport and economic growth. There is no consensus on the topic owing to various reasons including the use of different indicators for tourism, air transport and economic growth. Different methodologies are also employed in the analysis as well as different types of data (time series, panel data etc.). Country specific and region specific factors also result in differences in the results in existing literature. Opposing views exist on the relationship between, tourism and economic growth. These are namely; i.) Tourism growth causes GDP growth ii.) Economic growth causes tourism growth iii.) GDP growth causes tourism growth and tourism growth causes GDP growth (bi-directional causality) and iv.) There is no causal relationship between GDP growth and tourism growth. (Gwenhure & Odhiambo, 2017) Several studies have found evidence of the tourism-led growth hypothesis in Europe. (Lee & Chang, 2008; Arslanturk & Atan, 2012; Cárdenas-García et al., 2015; Chiu & Yeh, 2016; De Vita & Kyaw, 2016) Kreishan (2015) and Jalil et al. (2013) used ARDL bounds testing on data for Bahrain and Pakistan respectively and found evidence of tourism led growth. Risso and Brida (2008) and Brida et al. (2016) found evidence of tourism led growth in South America. Numerous studies in Asia also confirm the tourism led growth hypothesis namely; Chen and Chiou-Wei (2009); Caglayan et al. (2012); Narayna, Sharma and Banningidadmath (2013); Tang and Tan (2013). Limited research in Africa exists on the tourism led growth hypothesis. (Durbarry, 2004; Obadiah et al., 2012; Akinboade & Braimah, 2010) Evidence of the unidirectional causal flow from economic growth to tourism growth has been demonstrated by Odhiambo (2011); Chou (2013); Oh (2005); Payne and Merva (2010) and Suresh and Senthilnathan (2014). Similarly, evidence of the unidirectional nature of the relationship between GDP and tourism was found. (Seghir et al., 2015; Tugcu, 2014; Apergis & Payne, 2012; Khalil et al., 2007) Despite the vast evidence on causality between tourism and GDP some studies have found no evidence of causality between the variables. (Eugenio-Martins & Morales, 2004; Brida et al., 2011; Katircioglu, 2009; Kasimati, 2011)

For long term strategic planning and targeted investments in both air transportation and tourism, a need exists to further explore whether causal relationship exists between economic growth, air transport and tourism in unique emerging economies like South Africa. This paper, adds to the limited existing literature on the causal relationship between air transport, tourism and economic growth by employing correlation and econometric analyses.

3. Research Method

3.1. Data Sources

Air transport was assessed using three variables namely; air freight (FRT), number passengers carried by air (PAX) and number of registered air carrier departures worldwide (RCA). Tourism comprised two variables namely; international tourism expenditure (ITE) and international tourism receipts (ITR). Economic growth is measured by real gross domestic products (GDP) figures (constant at 2010 prices). Data for all variables was obtained from the World Banks's world development indicators' database for the period 1995 to 2015.

3.2. Data Analysis

Annual percentage changes (APC) and p-values were calculated in order to quantify the changes in the six variables over time. The Joinpoint regression Program, version 4.6.0.0 was used. The linear on the log of the GDP for example was used in the joinpoint regression model to calculate annual

percentage rate changes. (Joinpoint Regression Program, 2018) The maximum number of Joinpoints was set to three in order to avoid capturing unstable trends due to relatively small number of data points for the air freight data. A p-value less than 0.05 presents a statistically significant change. In addition, to explore associations between GDP with both air transport and tourism indicators, scatter plots were mapped, to which a linear regression line was fitted to calculate the R-squared values. The R-squared values express the proportion of variance explained by GDP for both air transport and tourism. Though this technique is predominately used for associations related to individual data it gives an overview of the probable variance explained by a factor in the outcome variables.

Button and Yuan (2013) explained that traditional correlation tests do not detect spurious or coincidental associations nor do they determine underlying causal linkages and direction of causality. As a result four step econometric analysis approach was applied to investigate the causal relationship between air transport, tourism and GDP. Firstly, each series was tested for stationarity, as only variables with the same level of stationarity or order of integration can be used for further tests of causality. (Granger, 1988) The Augmented Dickey Fuller (ADF) test together with the Phillips-Perron test were conducted to test the series for stationarity at level I(0), first difference I(1) and second difference 1(2) respectively. (Dickey & Fuller, 1981; Phillips & Perron, 1988) The ADF test is known to have weak predictive power compared to other stationarity tests and as a result the Phillips-Perron (PP) test was used to confirm the results of the ADF test. (Hakim & Merket, 2016)

Once stationarity was determined, co-integration was tested using the Johansen cointegration test as the second step. (Johansen & Juselius, 1990) Cointegration tests were performed for variables that were stationary at the same order that is either order 1 or order 2. If variables are integrated at level 1(0), then standard time series tests must be performed. (Enders, 1995) Cointegration tests including a trend as well as one with no deterministic trend were used to test for the presence of the long run relationships of the two variables. (Enders, 1995)

Thirdly, Granger causality tests were performed to determine causality between variables integrated of the same order. (Engel & Granger, 1987) The Grange causality test inferred whether for example GDP Granger causes ITR and vice versa. The Granger causality test compares the lagged change in GDP with the lagged change tourism variable and vice versa. Lastly, depending on whether or not there is cointegration either a vector error correction (VECM) or a vector autoregressive model (VAR) is fitted to test for linear inter-dependencies among the variables. Eviews version 9 was used to conduct the econometrics analysis.

4. Results

Figure 1 presents overtime trends for air transport indicators between 1995 and 2015. Through Joinpoint regressions, a significant increase in APC was observed in the period 1995 -2000 for air freight (FRT) (APC; 24.35%; $p<0.001$) whilst a significant decrease was observed between the years 2000-2015 (APC;-1.92%; $p=0.001$). For the number of passengers carried (PAX), a substantial APC was observed between 2008 and 2015 (APC; 95.36%: $p<0.05$). A significant increase of 285% was observed for the number of registered carriers (RCA) in the period under review.

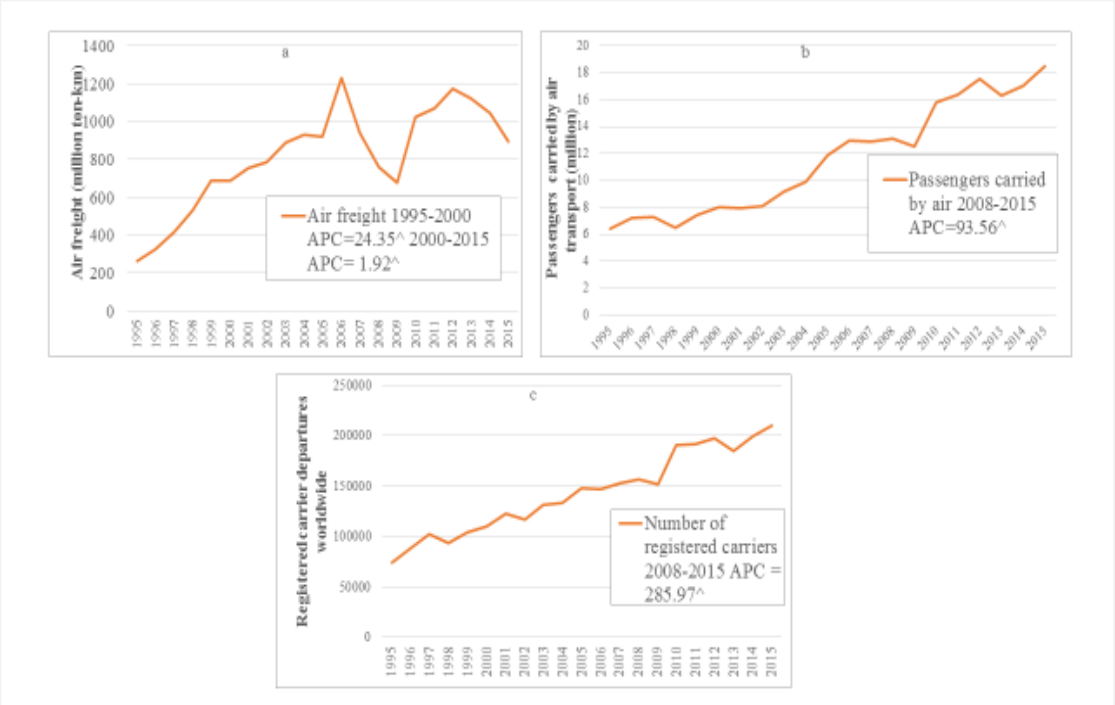

Figure 1. Time trends for air transport indicators between 1995 and 2015

^ Indicates APC is significantly different from zero at 95% confidence interval. APC = Annual Percentage Change

Overtime trends for tourism indicators and GDP between 1995 and 2015 are presented in Figure 2. Significant increases were observed in international tourism expenditures (ITE) between 2002 and 2006 (APC; 41.64% p=0.01) and between 2006 and 2015 (APC; 5.08% p=0.01). International tourism receipts (ITR) increased with an APC of 8.74% (p=0.01) between 1995 and 2007 although a fluctuating trend was observed thereafter. For GDP an overall significant increase is observed between 1995 and 2015.

Figure 2. Time trends for tourism indicators and GDP between 1995 and 2015

^ Indicates APC is significantly different from zero at 95% confidence interval. APC = Annual Percentage Change

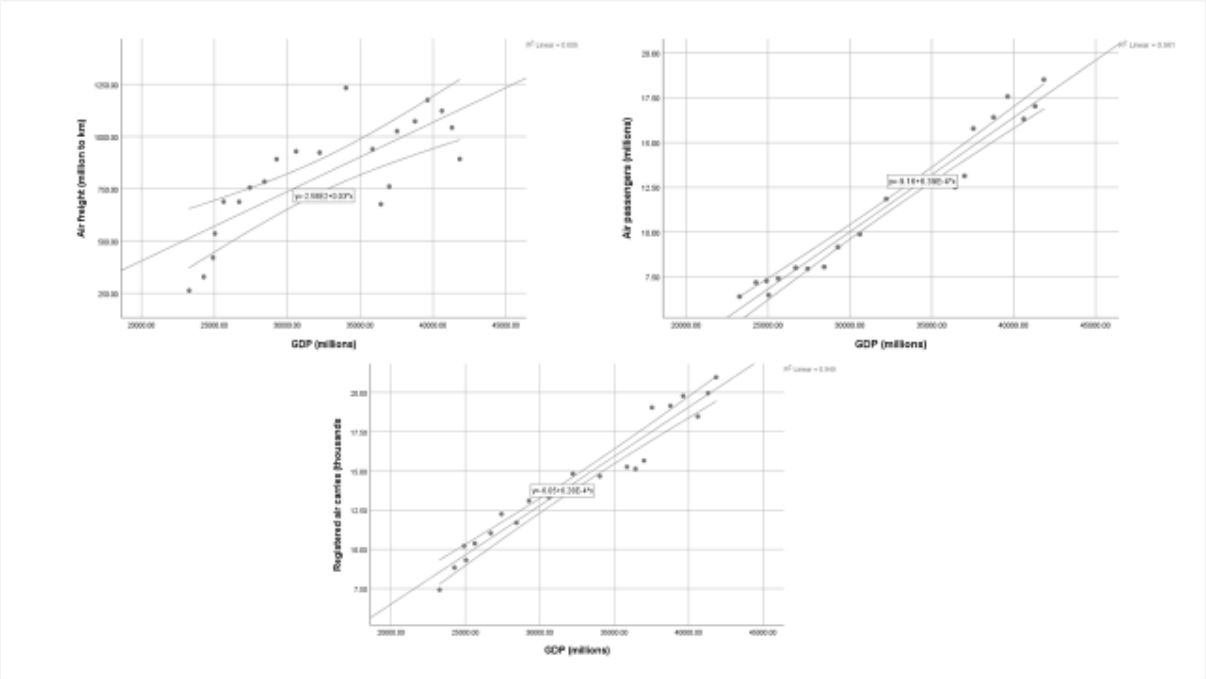

Figure 3. Associations between air transport variables and GDP: Scatterplots with fitted regression line

- *a) Associations between air freight and GDP: Scatterplots with fitted regression line*
- *b) Associations between air passenger and GDP: Scatterplots with fitted regression line*
- *c) Associations between registered air carriers and GDP: Scatterplots with fitted regression line*

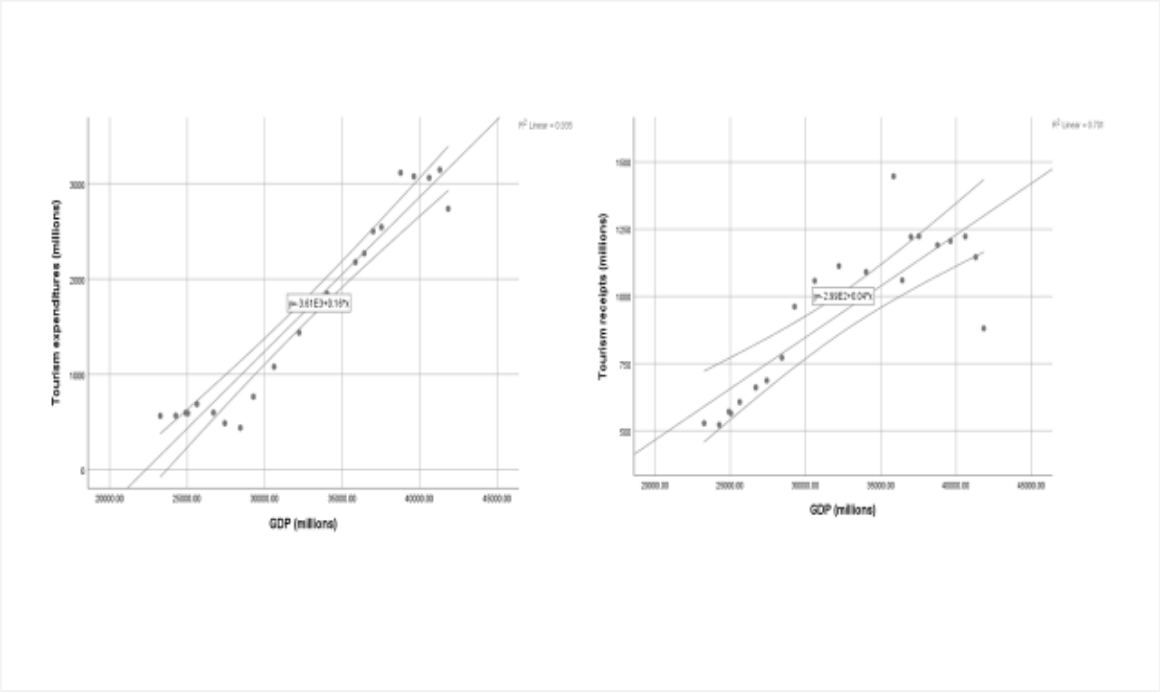

Figure 4. Associations between air transport variables and GDP: Scatterplots with fitted regression line

a) Associations between tourism expenditure and GDP: Scatterplots with fitted regression line

b) Associations between tourism receipts and GDP: Scatterplots with fitted regression line

R-squared values indicates that GDP explained a probable 96.1%, 60.6%, 94.9%, 93.5%%, and 70.1% of the variance for air passengers, air freight, number of registered carriers, tourism expenditure and tourism receipts respectively (see Figures 3 and 4).

In the current analysis to be able to test for causality between GDP and variables, unit root tests were computed to determine stationarity of the variables. Table 1 shows the results for ADF and PP tests for stationarity for the air transport variables; and Table 2 shows the results for tourism variables and GDP between 1995 and 2015. If the unit root test for a series is $p > 0.05$ then the null hypothesis of no unit root cannot be rejected for all series, while the null hypothesis can be rejected if $p < 0.05$ for all series. Table 1 shows that the probability of air transport variables with an intercept (no trend) and trend at level, for both the ADF and PP tests, is greater than 0.05 implying that the null hypothesis cannot be rejected. Both the ADF and the PP tests show that air transport variables are not stationary at level. When the first differences are taken, the air transport variables become stationary, for both the ADF and PP tests. For the tourism variables and GDP the null hypothesis cannot be rejected at level and first difference. However, when the second difference were taken, all three variables became stationary. It is evident that the three air transport variables are stationary at first difference 1(1) ($p<0.05$) while the tourism variables and GDP are stationary at second difference 1(2) ($p<0.05$).

Table 1. Air transport unit root test results

Variable	ADF (no trend)		ADF (trend)		PP (no trend)		PP (trend)	
	Level	1st diff	Level	1st diff	Level	1st diff	Level	1st diff
FRT	0.19	0.01	0.56	0.02	0.18	0.00	0.54	0.01
PAX	0.96	0.03	0.07	0.01	0.99	0.00	0.32	0.00
RCA	0.93	0.001	0.013	0.007	0.90	0.00	0.007	0.00

Table 2. Tourism and GDP unit root test results

Variable	ADF (no trend)			ADF (trend)			PP (no trend)			PP (trend)		
	Level	1st diff	2nd Diff	Level	1st diff	2nd Diff	Level	1st diff	2nd Diff	Level	1st diff	2nd Diff
ITE	0.88	0.11	0.00	0.54	0.39	0.00	0.87	0.13	0.00	0.69	0.45	0.00
ITR	0.48	0.01	0.00	0.97	0.06	0.00	0.49	0.01	0.00	0.98	0.01	0.00
GDP	0.95	0.06	0.00	0.28	0.20	0.00	0.95	0.06	0.00	0.71	0.20	0.00

Cointegration tests can be applied on series that are stationary at the same level to test for systematic long-term relationships. Therefore no further inference was made on the relationship between the air transport variables and GDP as they were not stationary at the same level. From the findings described above GDP, ITR and ITE were stationary at the second difference 1(2), hence the Johansen co-integration test was performed to explore long-run relationships between the variables. Table 3 presents the results of both the trace and maximum-eigenvalue statistics. In the cointegration test, the null hypothesis assumes no cointegration. No cointegration equations were found to be statistically significant. Therefore the null hypothesis of no cointegration could not be rejected implying that GDP and tourism do not have a no long run relationship.

Table 3. Results of the unrestricted co-integration rank test

	Unrestricted co-integration rank test (trace)[a]				Unrestricted co-integration rank test (maximum eigenvalue)[b]			
Hypothesized number of CE(s)	Eigenvalue	Trace statistic	Critical Value at 0.05	Probability**	Eigenvalue	Maximum eigen statistic	Critical Value at 0.05	Probability **
None	0.361394	15.97493	29.79707	0.7140	0.361394	8.520898	21.13162	0.8691
At most 1	0.316287	7.454033	15.49471	0.5255	0.316287	7.224111	14.26460	0.4630
At most 2	0.012028	0.229921	3.841466	0.6316	0.012028	0.229921	3.841466	0.6316
CE is cointegrating equation								
** denotes rejection of the hypothesis at the 0.05 level*								
***MacKinnon-Haug-Michelis (1999) p-values*								
Trace test indicates no cointegration at the 0.05 level								
Max-eigenvalue test indicates no cointegration at the 0.05 level								

Although no cointegration was observed pairwise Granger causality test was performed on these variables to determine possible interactions between variables. Table 4 illustrates that none of the variables of interest had a causal relationship therefore the authors fail to reject the null hypotheses that GDP does not Granger cause ITE and vice versa and secondly that GDP does not Granger cause ITR and vice versa.

Table 4. Granger causality test

Null Hypothesis:	F-Statistic	Prob.
ITR does not Granger Cause GDP	1.48340	0.2604
GDP does not Granger Cause ITR	0.36337	0.7017
ITE does not Granger Cause GDP	1.43860	0.2703
GDP does not Granger Cause ITE	1.53201	0.2502

Following the above findings, a vector auto-regression model (VAR) was computed to explore the associations between the variables. As no cointegration was found between the variables GDP, ITE and ITR, a VAR model was the most suitable model. The initial Durbin–Watson test statistic for autocorrelation showed the presence of positive autocorrelation. In order to correct for the positive autocorrelation two AR terms were added to the model. Table 5 shows the results of the VAR model with AR terms, corrected for positive autocorrelation. The findings show that GDP has a positive relationship with ITE and ITR, in that for 1 unit ($) increase in GDP we observe, a significant increase of a 0.16 cents (p=0.0001) and 0.18 cents (p=0.02) respectively. Overall GDP accounts for 97% of the variance related to ITE and ITR. These findings are substantiated by scatter plot findings shown in Figure 3 and 4,

Table 5. Vector auto-regression model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.374325	0.369648	22.65488	0.0000
LTOURISM_EXPENDITURES(-2)	0.165386	0.039156	4.223783	0.0010
LTOURISM_RECEIPTS(-2)	0.180632	0.070186	2.573603	0.0231
AR(1)	0.837268	0.320654	2.611126	0.0215
AR(2)	-0.383171	0.423456	-0.904865	0.3820
SIGMASQ	0.000184	0.000115	1.606467	0.1322
R-squared	0.970422	Mean dependent var		11.49049
Adjusted R-squared	0.959046	S.D. dependent var		0.081123
S.E. of regression	0.016417	Akaike info criterion		-5.088165
Sum squared resid	0.003504	Schwarz criterion		-4.789921
Log likelihood	54.33757	Hannan-Quinn criter.		-5.037690
F-statistic	85.30251	Durbin-Watson stat		1.967071
Prob(F-statistic)	0.000000			

5. Discussion

The aim of this study was to firstly illustrate and describe the overtime changes in trends in air transport, tourism and economic growth for South Africa between 1995 and 2015. Secondly, this study investigated the casual relationship between air transport, tourism and economic growth. Significant increases in APC were observed for air transport variables. The highest APC across all air transport indicators was observed between 2008 and 2015, for RCA (APC; 285.97%: p=0.001). Significant increases were also observed in ITE between and ITR while GDP experienced overall significant increase in APC. R-squared values indicated that GDP explained at least 90% of the variance in PAX, RCA and ITE respectively.

The volatility in the South African air transport market has been attributed to several factors including oil price volatility, hybridisation of airline models and IT advances (Luke 2015; Venter, 2017), weak passenger demand and high taxes and operating charges. (Pisa & Luke, 2018) The passenger air transport demand in South Africa is characterised as a luxury goods and tends to be relatively inelastic and to be negatively associated with price. (IATA, 2016) In addition market entry costs are considered higher than the global average and the open skies have not been appropriately implemented. This results in the fragmented bilateral agreements, dominance of state-owned airlines and resulting low levels of competitiveness in the sector. Similarly air cargo movements are strongly associated with trade and industrialisation (Boeing, 2016) and slow economic performance will thus negatively impact air cargo volumes.

The three air transport variables are stationary at first difference 1(1) while the tourism variables and GDP are stationary at second difference 1(2). No further inference on the relationship between air transport variables and GDP as they were not stationary at the same level. For both the trace and maximum-eigenvalue statistics, no cointegration equations were found to be statistically significant implying that the variables are not cointegrated. Similarly, the Granger causality test did not provide evidence of causality between GDP and tourism variables. Lastly the VAR model found that a large proportion of the variance in ITE and ITR is explained by GDP (R squared 97%) thus confirming the results of the scatterplots. The findings show that GDP has a positive relationship with ITE and ITR, in that for I unit ($) increase in GDP we observe, a significant increase of a 0.16 cents (p=0.0001) and 0.18 cents (p=0.02) respectively.

Differences with existing studies: The lack of a causal relationship may be attributed to that fact that the tourism sector accounts for a small proportion of South Africa's GDP and as a result does not have a sizable influence on the economy. Nene and Taivan (2017) found evidence of causality between tourism and economic growth in a panel study of 10 Sub-Saharan African countries including South Africa. The difference between these findings and those of the current study, particularly for South Africa, could be attributed to the use of panel data in the study by Nene and Taivan (2017) as opposed to time series data used in the current analysis. Hakim and Merket (2016), Hood et al. (2008) assert that panel Granger causality tests produce more accurate results compared to standard time series data. Akinbode and Braimoh (2010) found causality between international tourism receipts and real GDP in South Africa. The main difference of these findings with the current study is the use of different methodologies. This study used econometric analysis which has the ability to detect spurious or coincidental associations as well as identifying underlying causal linkages and direction of causality In the afore mentioned study used Sim's (1980) VAR model and dynamic Granger causality tests to test for causal relationships while the current study utilises the traditional Granger causality test.

Similarities with existing studies: The finding of this study are similar to those of Cárdenas-García,Sánchez-Rivero and Pulido-Fernández (2015) who found positive associations between tourism and economic growth but no causal relationship in low incomes countries and or countries with low growth prospects. This was attributed to insufficient or weak multiplier effects with no resultant causal effects. This may be the case for South Africa as the economy has been experiencing sluggish economic growth rates owing to market volatility and political uncertainty. As a result, investment in tourism may be generating weak multiplier effects that do not impact GDP (causality) and vice versa. Furthermore, Brida et al. (2011, Brazil); Arslanturk (2011, Turkey); Katircioglu (2009, Turkey); Kasimati (2011, Greece); Eugenio-Martins and Morales (2004, Latin America) also found no causal relationship between economic growth and tourism despite different methodologies being used in these studies. A similarity of these countries with South Africa is the low-middle income status hence further strengthening the above mentioned plausibility of weak multiplier effects.

Strengths and limitations: Because traditional correlation tests do not detect spurious or coincidental associations nor do they determine underlying causal linkages and direction of causality (Button & Yuan, 2013) this study used econometric analyses to ensure these challenges were addressed. In view of the ecological nature of the design, causal associations are not easy to ascertain though robust methods namely Granger causality and cointegration were used to assess this. Additionally, Joinpoint regressions were used to assess overtime changes in the associated variables.

In exploring the causal and possible associations, as set in the current analysis, limitations include not being able to adjust for other variables that are known to influence the associations of economic growth with the selected air transport and tourism variables such as infrastructure, exchange rate and trade amongst others. Additionally, the data used was for a short period of time resulting in the likelihood that longer term cycles may not have filtered down to the rest of the economy. Furthermore, ITE and ITR may not be adequate measures of tourism as they do not sufficiently capture the spill-overs of the tourism industry to the rest of the economy. Moreover, the study used macro-economic data which may not adequately decompose the regional effects of the airports or tourist dense regional economies thus the results may be different if regional data are used.

Policy implications of findings: Understanding various factors that can be causal determinants and/or underlying modifiers for air transports and tourisms has important policy implications for the entire transport and supply chain management cascade and the prioritisation of already pressured fiscal budgets especially for low-middle income countries. In the current analysis economic growth, explained much of the variance for overtime changes in the selected outcomes hence a pivotal distal driver for air transport outcomes and tourism. In South Africa, over the last decades, air transport demand has increased, with a growing middle class this has led to decreases in the cost of transportation of passenger and freight volumes, hence ultimately increasing accessibility. Growth in the air transport and tourism sectors within South Africa, improves regional competitiveness and supports economic, social and inter-cultural development. These results provide evidence of the association between air transport, tourism and economic growth. South Africa has advanced infrastructure and high per capita income growth relative to the rest of the continent. This implies strong potential market growth for both air transport demand and tourism.

6. Conclusion

The current analysis, highlights and illustrates that South Africa's economic growth associates with tourism, though causality could not be inferred. There is increasing concern for South Africa's economic growth, a need exists to explore its influence and spill overs to other sectors including air transport and tourism in a design that allows for the adjustment of other confounders and/or modifier effects.

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