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INVESTIGATION OF THE FACTORS AFFECTING TOURISM DEVELOPMENT PANEL CAUSALITY ANALYSIS: THE CASE OF BRICS COUNTRIES

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Abstract: This study investigates the causal relationships among the contribution of tourism income to GDP, international tourist arrivals, and capital investment in the travel and tourism sector in BRICS countries-Brazil, Russia, India, China, and South Africa-over the period 1995 to 2020. Using the Emirmahmutoğlu and Köse Panel Causality Test, which accounts for cross-sectional dependence and heterogeneity among panel units, the study systematically examines both unidirectional and bidirectional causal linkages among the three core variables. The empirical findings indicate a robust bidirectional causality between capital investment in tourism and both the GDP share of tourism income and international tourist arrivals, substantiating the feedback hypothesis. Additionally, the analysis identifies a unidirectional causality from international tourist arrivals to the GDP share of tourism income, thereby supporting the tourism-led growth hypothesis (TLGH). These causal patterns underscore the reinforcing dynamics between tourism development and economic performance in emerging economies. Country-level analyses reveal distinct heterogeneities. Brazil and South Africa exhibit bidirectional causality between capital investment and tourism income, while China and Russia display unidirectional causality from investment to GDP share. In India, a bidirectional link is found solely between tourist arrivals and tourism income. Moreover, the direction of causality between tourist arrivals and investment differs: in Brazil, investment leads to arrivals, whereas in South Africa, arrivals lead to investment. China demonstrates neutrality in some relationships, indicating no statistically significant causal effect. The study presents targeted policy recommendations grounded in these findings. These include increasing tourism-related capital investment, improving infrastructure, expanding international marketing, and enacting tourist-friendly regulations. Specific proposals include enhancing eco-tourism and airport infrastructure in Brazil, and promoting heritage tourism in China. The study acknowledges limitations such as potential endogeneity, omission of post-2020 data-including pandemic - related disruptions - and the exclusion of sociocultural and environmental variables. Nevertheless, it offers strong econometric support for the role of tourism in advancing sustainable economic growth, particularly within diverse and evolving emerging market contexts like those of the BRICS nations.

Keywords: tourism development, tourism growth, panel cointegration analysis, panel causality analysis, economic effects, GDP impact, BRICS countries

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INTRODUCTION

After the Second World War, the tourism sector became an industry, which provides the incentive of development and growth in the communication sector, information and transportation. Tourism has also become more important in economic, political and social terms. The World Tourism Organization (UNWTO) stated that despite the economic shocks experienced over the past 30 years, the international tourism sector has continued to exhibit exceptional growth, making it one of the industries with the fastest growth rates in the world. The number of International tourists worldwide increased from 25 million in 1950 to 278 million in 1980 to 674 million in 2000 and finally to 2.4 billion in 2019. The number of international tourists for Brazil, China, India, Russian Federation and South Africa increased 3.19, 3.50, 8.43, 2.37 and 3.16 times in 2020 compared to 1995, respectively. Meanwhile the international tourism revenues have also been increasing accordingly. The global tourist industry generated 2 billion US dollars in revenue in 1950, 104 billion US dollars in 1980, 495 billion US dollars in 2000, and 14.65 trillion US dollars in 2019. Considering this trend of development, it is estimated that in 2030, worldwide the annual increase of international tourists will be 3.3% between 2010 and 2030, reaching 1.8 billion in 2030, respectively. The foreign exchange revenues from the sale of the tours to international tourists has had a positive effect on the balance of payments of these countries and their GDP's (UNWTO, 2020). Despite these aggregate trends, BRICS countries exhibit significant economic and structural diversity, necessitating a nuanced analysis of tourism dynamics (see country-specific results in Tables 5 – 7 and Figure 1).

Unlike other goods exported from a country, tourism is also valued as an invisible export or "smokeless industry" as it provides nothing but gifts in the provision of tourism services. Therefore, it is possible to assess the role of tourism

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revenues and international tourists in the country's economy in terms of the level of economic activity in the country, the international value and grading of the national currency. For this reason, there has been a rise in countries' investments in tourism - the "smokeless industry" (Seghir, 2015). The world Index of Capital investment in Travel and Tourism for Brazil, China, India, Russian Federation, and South Africa has increased by 2.76, 8.77, 10.30, 1.98 and 4.35 times in 2020 compared to 1995, respectively. According to the feedback hypothesis, the increase in the number of international tourists and capital investment in Travel and Tourism results in an increase the tourism income to GDP ratio, as the tourism income to GDP ratio also increases. The Figure 2 in the Appendix shows the tourism income in GDP ratio for the BRICS countries and the entire World. According to the numbers shown in the Graph, the ratio of tourism income in GDP decreased between 2006 and 2010 due to the global financial crisis in 2008.

However, the overall, picture displays an average increase in the ratio of tourism income to GDP in BRICS countries except for China and the Russian Federation. The ratio of tourism income to GDP for Brazil, India, South Africa, and the entire world increased by 2.53, 1.49, 1.75, and 1.22 times in 2020 compared to 1995, respectively. Whereas, the ratio of tourism income to GDP, for China and the Russian Federation decreased by 4.74 and 1.68 in 2020 compared to 1995, respectively (UNWTO, 2020). The purpose of this study is to examine the causal relationships among tourism income's contribution to GDP, international tourist arrivals, and capital investment in the travel and tourism sector within the BRICS countries - Brazil, Russia, India, China, and South Africa - over the period from 1995 to 2020.

By employing the Emirmahmutoğlu & Köse Panel Causality Test, the research aims to identify how these factors interact and influence tourism development, revealing both bidirectional and unidirectional causalities that highlight their interdependent dynamics. Ultimately, the study seeks to provide evidence-based insights for policymakers to enhance tourism's economic impact through targeted investments and strategies in these emerging economies.

LITERATURE REVIEW

The tourism industry significantly influences the social and economic progress of countries. Economically, it brings together a wide range of producers and consumers, while also promoting the exchange of knowledge and connections between nations and individuals through natural, social, and cultural elements. The demand for goods and services to meet people's needs requires their continuous renewal to address emerging desires, ultimately leading to increased income in this sector (Huseynli & Huseynli, 2023). Tourism has long been acknowledged as a key driver of the global economy. Based on the World Travel & Tourism Council's 2023 Annual Research Report, the travel and tourism industry added USD 9.9 trillion to the global economy, accounting for 9.1% of the world's GDP (Liu & Chamaratana, 2025).

In 2019, the tourism industry contributed to 10.6% of worldwide jobs and 10.4% of the global gross domestic product (GDP). Although it faced severe challenges due to the COVID-19 pandemic in 2019 and 2020, which disrupted human movement and social interactions-key pillars of tourism's sustainability-the sector still managed to account for more than 5.5% of global GDP in 2022 (Makhanyela et al., 2024). According to literature, there has been a significant increase in studies conducted in recent years examining the relationship between tourism and economic growth. In this study the relationship between the ratio of tourism income to GDP, the number of arrivals of international tourists and the capital investment in travel and tourism, has been analyzed. Wijesekara et al. (2022) used Granger causality and wavelet coherence to reveal a two-way link between tourism and economic growth across 105 countries. Their study highlights how tourism's economic impact varies by region, suggesting similar dynamics may apply to BRICS nations. This supports the use of panel causality methods to explore diverse factors driving tourism development in these emerging economies.

Rasool et al. (2021) applied panel cointegration and Granger causality tests to confirm a bidirectional relationship between tourism and economic growth in BRICS countries over 1995-2015, emphasizing the sector's role as a key economic driver. Their findings underscore the importance of financial development alongside tourism inflows, providing a foundation for analyzing broader factors influencing tourism development in the BRICS context using similar panel causality approaches. Mishra et al. (2021) investigated the tourism-led growth hypothesis in BRICS countries using panel Granger causality tests, finding mixed evidence of unidirectional and bidirectional causality between tourism receipts and economic growth across the region from 1995 to 2019. Their emphasis on country-specific variations in tourism's economic impact highlights the relevance of applying panel causality analysis to diverse emerging markets like BRICS, where similar heterogeneity may influence tourism development factors.

Empirical tests have been conducted by many researchers to analyze the causal relationship between the ratio of tourism income to GDP with the number of arrivals of international tourism and the capital investment in travel and tourism. Due to the differences in the researches in terms of time schedules, country profiles and survey methods held by researchers, different results were estimated (Pata, 2021). As a result, four different hypotheses can be used to analyze the causal linkages between economic growth, tourism revenues, and the number of tourists described in our study.

i) The tourism-led growth hypothesis (TLGH) proposed by Balaguer & Cantavella-Jordá (2002) is based on the idea that tourism with an export focus is a strong economic growth driver. According to TLGH, the rise in the proportion of tourism income to GDP and the quantity of foreign visitors, two elements that affect tourism, would lead to new investment and employment prospects. Therefore, tourism will contribute to economic growth. Resultantly, TLGH demonstrates a unidirectional causal relationship between tourism and economic growth (Balaguer & Cantavella-Jorda, 2002).

Dritsakis's study in 2004 testing TLGH by applying test for causality by Granger and the Multivariate Auto-Regressive model in Greece's research on the impact of international tourism revenue and exchange rates on economic growth between the years 1960-2000. The study's conclusions suggest that foreign tourism earnings and the value of currency have a favorable impact on economic expansion (Dritsakis, 2004). In their research, Kum et al. (2015) examined the link between

the number of foreign visitors and GDP for 11 countries for the period 1995-2013 using DOLS and FMOLS panel co-integration techniques and a causality test. The rise in foreign visitors was found to have a long-term beneficial impact on GDP and TLGH, according to the estimation results of the DOLS and FMOLS co-integration methodologies. The results of the causality test showed that economic expansion has a one-way impact on tourism. The economically driven tourist growth theory was been proven by a unidirectional causality linking economic growth to tourism. The Granger causality approach was utilized in Ribeiro's analysis to look at the connection between real exchange rate, GDP, tourism revenues, and foreign direct investments between 1997 and 2018. As a result of tests, a unidirectional relationship was found among tourism revenues, real exchange rate and foreign direct investments to GDP and therefore TLGH was also proven in this study. Furthermore, the results of studies by Solarin (2018), Gunduz & Hatemi-J (2004), Chiu & Yeh (2017), Tang & Tan (2015), Al-Mulali et al. (2014), Aslan (2014), and Ertugrul & Mangir (2015) were also compatible with TLGH.

ii) According to the economically driven tourism growth hypothesis (EDTGH), expansion fosters tourism's growth and opens up new employment prospects through raising industry demand. As the economy of a country grows, the income of the society also increases. Increasing incomes increase the level of welfare and this creates touristic and recreational needs amongst people. Thus, the increase in tourism demand and the rise in touristic expenditures accelerate investments for tourism. As a result, the EDTGH shows a one-way causal association among economic growth, capital investment in travel and tourism, and tourism-related revenue. The relationship between economic growth, real tourism revenues, and the number of tourists per capita in OECD and non-OECD (including Asia, Latin America, and Sub-Saharan Africa) countries between 1990 and 2002 was examined by Chien-Chiang Lee & Chun-Ping Chang using long-run cointegration (FMLOS) and causality tests. As a result, real tourism revenues and the number of tourists per capita were found to have unidirectional causality ties with economic growth in OECD nations and bidirectional causality relationships between variables in non-OECD countries (Lee & Chang, 2008). In a study published by Antonakakis et al. (2015) using monthly data for 10 European nations for the period between 1995 and 2012, the Granger causality test was conducted to establish the relationship between economic growth and the tourism industry. As a result, it was found that the economically driven tourism growth hypothesis (EDTGH) and the tourist-led economic growth hypothesis (TLGH) are time-dependent and may vary by country (Antonakakis et al., 2015). Additionally, the researches carried out by Ghosh (2011), Oh (2005), Narayan (2004), Tang & Jang (2009), and Payne & Mervar (2010), also proved the economically driven tourism growth hypothesis (EDTGH), shows that tourism factors improve as economic growth increases.

iii) Thirdly the feedback hypothesis. The theory holds that factors affecting economic growth and those affecting tourism interact and complement one another, demonstrating a causal relationship that runs in both directions. In other words, economic growth fuels the development of tourism-related factors, whereas tourism-related factor growth fuels economic growth. In this study, one of the literature studies on BRICS countries and their hypotheses is the study reviewed by Rasool et al. (2021) using the ARDL co-integration test and Dumitrescu Hurlin panel causality test to examine the linkages between international tourism income per capita, financial development, and GDP per capita for five BRICS countries between 1995 and 2015. The panel ARDL co-integration test results demonstrated a positive long-term co-integration between economic growth, international tourism receipts per capita, and financial development. The "feedback-hypothesis" was thus established in the BRICS nations as a result of the Granger causality analysis's findings that there is a bidirectional causal relationship between international tourism income per capita and economic growth (Rasool et al., 2021). For the years 1990–2007, Seetanah examined the connection between tourism and economic growth in 19 island nations using the Granger causality test. The study's findings revealed that there is a bidirectional causal relationship between tourism and economic growth, demonstrating the validity of the feedback hypothesis (Seetanah, 2011). As a result of the studies conducted by Tugcu (2014), Lee & Chang (2008), Bilen et al. (2017), Lorde et al. (2011), Dogru & Bulut (2018), and Kim & Chen (2006) the feedback hypothesis was found to be applicable. The tourism-led growth hypothesis is supported by Mishra's (2021) study, which used the ARDL regression method to look at the relationship between tourism and economic growth in the context of the BRICS countries between 1995 and 2019. The study found that international tourist arrivals, international tourism revenues, and international tourism expenditures all have a positive impact on economic growth (Mishra et al., 2021).

iv) According to the neutrality hypothesis, there is no connection between the two variables, and they have no impact on one another. This theory states that any change in the economy is not attributed to any relationship between tourism and economic growth. According to research by Katircioglu (2009), Ekanayake & Long (2012), Wu et al. (2018), and others, the neutrality hypothesis was applicable in the cases they examined.

MATERIAL AND METHOD

Data

In the model, the causality between the ratio of tourism income to GDP, capital investment in travel and tourism, and the number of foreign tourist arrivals was examined. In order to analyze the data set obtained from sources presented in Table 1, the panel time series analysis was performed with the STATA 2017, GAUSS 16 and E-Views 12 package programs, which are accepted as statistical and econometric program packages. Thus, the dependent and independent variable data of five BRICS countries between the 1995-2020 periods were selected.

According to the statistical results of the collected data, all data included in the analysis was converted into logarithmic form, taking into account the fold differences between the observation values. Table 1 below shows the main sources, units, definitions and abbreviations from which the data was obtained. Descriptive statistics of these variables are presented in Table 2, revealing the logarithmic transformation applied to address fold differences.

Table 1. Independent and Dependent Variable by data source

Symbol	Definition	Unit	Source
TG	Ratio of tourism income in GDP	Ratio 0-1	The World Bank, www.data.worldbank.org
TN	The number of arrivals of international tourism	Million people	The World Bank, www.data.worldbank.org
TI	Capital investment in Travel and Tourism	Billion US ($)	Trade and Competitiveness Data www.tcdata360.worldbank.org
Dates and Countries using in the Analysis			
Name of Countries			**Dates**
Brazil, Russian Federation, India, China, South Africa (BRICS Countries)			Between 1995 – 2020 (Total 26 year)

Table 2. Descriptive statistics of variables used in the model

Variable	Observations	Mean	Std. dev.	Min	Max
TG	130	-2.675	1.186	-5.926	-0.894
TN	130	2.616	1.226	0.689	5.091
TI	130	2.570	1.215	0.300	5.242

In our study, a balanced panel data was established with 130 observations for all countries, and the series and descriptive statistics of the dependent and independent variables included in the research were shown in Table 2 and Figure 1.

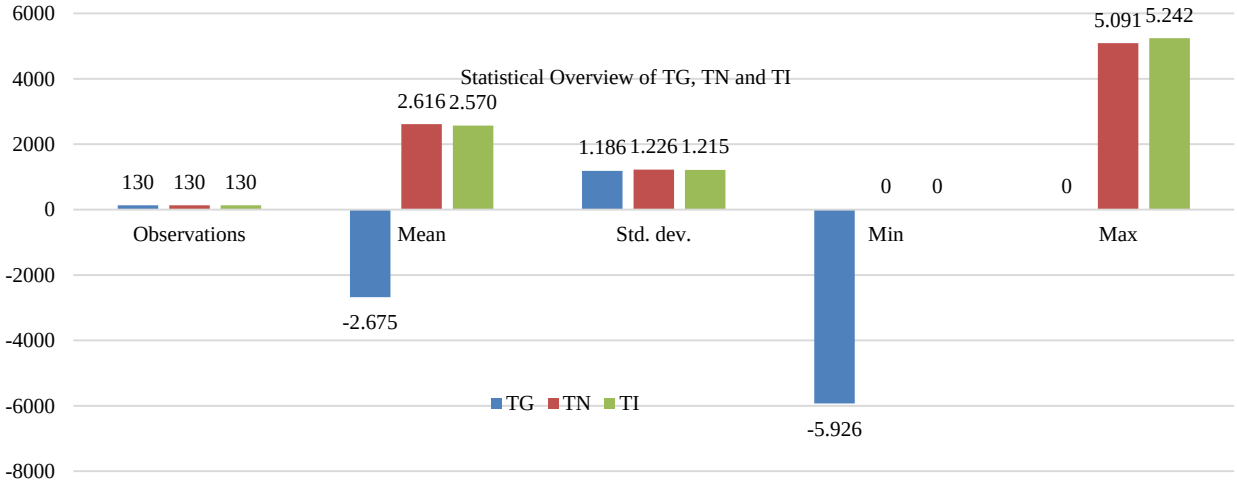

Figure 1. Descriptive statistics of variables used in the model

Method

The empirical analysis of the study was implemented in three stages to examine the relationship between the tourism income to GDP ratio, travel and tourism capital investments, and the number of international tourism arrivals. In the first stage, the model was tested for panel cross-sectional dependence using the Breusch-Pagan, LM Pesaran scaled LM and Pesaran CD. In the second stage, the stationarity levels of the variables were analyzed using the CIPS test for unit roots developed by Pesaran, which considers the cross-section dependence of the series. Finally, Emirmahmutoğlu and Köse test for panel causality was used to establish whether a causality relationship existed between the variables. While the Emirmahmutoğlu and Köse Panel Causality Test accounts for heterogeneity and cross-sectional dependence (see Table 3), we recognize potential limitations such as endogeneity and model specification biases. To ensure robustness, future analyses could incorporate additional tests, such as the Dumitrescu-Hurlin approach, to validate the causal relationships observed in Tables 5-7. These steps would further address unobservable factors that might affect the accuracy of our results.

Cross-Sectional Dependence Tests

According to the results of the Cross-Sectional Dependence test, economic integration between nations or unions grew as a result of the world's countries' burgeoning economic cooperation and globalization. Increasing economic integration between countries has made countries economically dependent on each other. It is foreseen that it is inevitable that economic shocks and mobility in a country or unit will affect other countries or unit at different levels (Demez, 2021). When working in panel data models, the cross- sectional dependence amongst countries or entities should be taken into account. If the cross- sectional dependence is ignored, serious erroneous parameters may occur in the estimation results (Chudic & Pesaran, 2013). Therefore, it is important to test both as variables and as a model in order to avoid erroneous parameters and to measure whether there is a cross-sectional dependence between the units (Ugur, 2021). For the cross-sectional dependence between units not to cause biased results in analysis using panel data, first-generation tests in case of cross-sectional independence and second-generation tests in case of cross-sectional dependence tests and estimators should be used (Aydin & Turan, 2020). There are a number of tests in the literature to identify cross-sectional dependence. In this study, Breusch-Pagan (1980) LM_{BP}, Pesaran (2004) scaled LM and Pesaran (2004) CD tests were conducted to check for cross-sectional dependence.

Breusch and Pagan (1980) Test

The correlation coefficients of the residuals serve as the foundation for the Lagrange Multiplier test at T → ∞ cases, while N is constant in the Breusch and Pagan (1980) test. LM_{BP} test founded on the correlation between errors bρij and the test statistics generated using the following equation (Breusch & Pagan, 1980).

$$LM_{BP} = T\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}^2 \quad (1)$$

(X^2; $\frac{N(N-1)}{2}$) at Chi-square asymptotic distribution and degrees of freedom in case of (T> N).

Where, the $\hat{p}_{ij}^2$ indicates the sample predictived cross-section correlation coefficients value of the equation between the residuals. According to Breusch & Pagan (1980) LM_{BP} test, the no dependence in cross-sections null hypothesis is tested against the alternative hypothesis of unit dependence between cross sections.

Pesaran scaled LM Test

Pesaran (2004) criticized the LM BP test's declining potency as the number of cross-section units (N) increased and even the test's inapplicability in situations where N→∞. Thus, he recommended by overcoming these problems, the following scaled version of CD_{LM1} that for testing the hypothesis for existence of cross dependence even for large N and T values:

$$CD_{LM1} = \sqrt{\frac{1}{N(N-1)}}\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}(T\,\hat{p}_{ij}^2 - 1) \quad (2)$$

According to Pesaran (2004) CD_{LM1} test, presumably, there is no cross-sectional dependence when $T\to\infty$ ve $N\to\infty$. However, in cases where N>T, the CD_{LM1} test shows significant distortions and the deviations increase as N gets larger (Pesaran, 2004).

Pesaran CD Test

In order to overcome the problems of significant distortions and the increase in deviations as N gets larger, Pesaran (2004) developed the test statistics consists of the sum of the correlation coefficients between cross-section residuals. According to Pesaran (2004) CD_{LM2} test, the absence of cross-sectional dependence is also presumed when $T\to\infty$ ve $N\to\infty$ and in the event when the cross-sectional size (N) is greater than the time dimension (T) where (N > T), the test statistic should be applied. Pesaran CD test statistic is calculated with the following formula:

$$CD_{LM2} = \sqrt{\frac{2T}{N(N-1)}}\left(\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{p}_{ij}^2\right) \quad (3)$$

Under the H_0 hypothesis, this test statistic exhibits a typical normal distribution, demonstrating that there is no correlation between the cross-sections (Pesaran, 2004; Guloglu & Ivrendi, 2010).

The null and alternative hypotheses used for the cross-sectional dependence test are as follows:

H_0: $Cov(u_{it};\ u_{ij})=0$, There is no cross-sectional dependence.

H_a: $Cov(u_{it};\ u_{ij})\neq 0$, There is a cross-sectional dependence.

In order to interpret the test findings, the null hypothesis cannot be rejected if the estimated probability values are greater than the significance values (Aydin, 2019). First generation panel unit root tests are valid in this situation. In contrast, the null hypothesis is rejected and there is cross-sectional dependence between the units if the estimated probability values are less than the significance values. Second generation panel unit root tests are valid in this scenario (Baltagı, 2008).

Panel Unit Root Tests

According to the cross-section dependence test results from Breusch & Pagan (1980) LM, Pesaran (2004) scaled LM, and Pesaran (2004) CD, which are presented in Table 3 below, the null hypothesis was rejected because the calculated probability values were lower than the significance values at 1 percent, 5 percent, and 10 percent. This indicates that there was cross-sectional dependence between the countries. Thus, the study used second generation unit root tests for panel data (Yerdelen, 2020). Second generation CIPS panel unit root test developed by Pesaran (2004, 2007) were used in the analysis.

CIPS Panel unit root tests

Pesaran CADF unit root tests for panel data is an expanded form of ADF regression with first differences of individual series and cross-sectional means of lag levels. Assuming cross-section dependence, CIPS and CADF tests can be used for cases where both *T*>*N* and *N*>*T*. Accordingly, the CADF regression can be written as in formula (4) below (Pesaran, 2007).

$$\Delta Y_{it} = a_i + b_i Y_{i,t-1} + c_i\overline{Y}_{t-1} + d_i\Delta\overline{Y}_t + \varepsilon_{i,t} \quad (4)$$

where, ΔY_{it} is Critical values of the CIPS test, $Y_{i,t-1}$, $\overline{Y}_{t-1}$and $\Delta\overline{Y}_t$ is Non-constant, constant and constant trend values based on Least Squares regression, respectively and $\varepsilon_{i,t}$ is the error term. The cross-sectional augmented ADF (CADF) panel unit root test, which is computed for each section unit, is the basis for CIPS test statistics. A cross-sectional enhanced version of the IPS test was proposed by Pesaran.

$$CIPS = N^{-1}\sum_{i-1}^{N} CADF_i \quad (5)$$

The unit root and stationarity are shown by the null and alternate hypotheses for the CIPS panel unit root tests. The test findings show that the unit root exists since the null hypothesis cannot be rejected because the calculated values are greater than the critical values. In contrast, the null hypothesis is rejected and stationarity exists if the estimated values are lower than the critical value values (Mercan et al., 2015).

Panel Causality Test

The study employed the Emirmahmutolu and Köse causality test for panel data to look at the relationship between capital investment in travel and tourism, the tourism income to GDP ratio, and the number of international tourists arrivals. The main feature of causality test for panel data is a dedicated test for causality on heterogeneity of the coefficients. Additionally, in this method, regardless of whether the variables are stationary or cointegrated, it is assumed that inter-country heterogeneity is valid, and this assumption adds flexibility to the method (Özcan, 2016).

A technique to examine Granger causality was created by Toda & Yamamoto in 1995 and is based on the adjusted VAR model (Gurdal et al., 2021). Emirmahmutoğlu & Köse (2011) Granger test for causality is founded on Toda and Yamamoto test for causality in 2011 (Toda & Yamamoto, 1995). When the series are stable at different levels, that is, when some of the series are I(0) and others are I(1), the Emirmahmutolu and Köse causality test, which considers the cross-sectional dependence, can be applied (Şaşmaz & Yayla, 2018). For further testing for causality, the lagged VAR model (ki + d maxi) is as follows (Emirmahmutoglu & Kose, 2011).

$$Y_{i,t} = a_{1,i} + \sum_{j=1}^{k_i+d\,max_i} \beta_{1,ij}\, Y_{i,t-j} + \sum_{j=1}^{k_i+d\,max_i} \delta_{1,ij} X_{i,t-j} + \varepsilon_{1,it} \quad (6)$$

$$X_{i,t} = a_{2,i} + \sum_{j=1}^{k_i+d\,max_i} \beta_{2,ij}\, Y_{i,t-j} + \sum_{j=1}^{k_i+d\,max_i} \delta_{2,ij} X_{i,t-j} + \varepsilon_{2,it} \quad (7)$$

Where, d maxi and k_i indicate the maximum integration order and the appropriate lag length of the variables, respectively. t denotes the time component (t = 1, .., T). and N denotes the number of cross-section units (j = 1, .., N). In the Emirmahmutoğlu and Köse panel causality test, null and alternative hypotheses are established as there is no causal relationship among variables and there is a causal relationship among variables, respectively.

RESULTS

As a result of the rise in cooperation and integration between countries due to the globalizing world, macroeconomic variables of countries have become interdependent and economic shocks in any one of the countries directly or indirectly influences the other country. Breusch & Pagan's (1980) LM, Pesaran's (2004) scaled LM, and Pesaran's (2004) CD tests were used to evaluate both the variables and the analysis's model to see if there was any cross-sectional dependence. Table 3 presents the cross-sectional dependence test results, demonstrating significant interdependence across BRICS countries at the 1% level.

Table 3. Cross-Section Dependence Tests Results

Tests for Cross-Sectional Dependence by Variables			
Variables	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD
TG	138.5645*	28.7479*	11.4672*
TN	132.4205*	27.3741*	11.1614*
TI	192.9339*	40.8053*	13.8021*
Model	107.2119*	21.7372*	9.6817*
* Indicates that the null hypothesis is rejected at the 1% significance level			

The null hypothesis was rejected and there is cross-sectional dependence in terms of the variables and the model, according to the results of the cross-sectional dependence tests for both the model and the variables shown in Table 3. The calculated probability values are smaller than the significance values at 1 percent. There is a cross-section dependency between countries, that is, the economic shock that may occur to any of the countries used in the model will also affect other countries. In this instance, the study should apply second generation unit root tests for panel data.

This study utilized the second-generation heterogeneous test and the CIPS test for unit roots. In addition, it was investigated if this study has constant-trend and/or constant. As the results of the figure 3, 4 and 5 shown in the appendix, this study does not contain trend and for the reason, CIPS unit root test was used at constant. The constant CIPS test for unit roots results are presented in table 4 below.

Table 4. CIPS panel unit root test results

Variables	**Level**		**First Differences**
TG	-1.689		-4.722*
TN	-2.185		-3.822*
TI	-3.034*		-5.133*
Critical values	-2.21 (10%)	-2.33 (5%)	-2.57(1%)
* Indicates that the null hypothesis is rejected at the 1% significance level			

The number of international tourist arrivals, the tourism income to GDP ratio at the first differences (I), and capital investment in travel and tourism at the level (O), as determined by the CIPS panel unit root test results presented in Table 4, were stationary. According to the findings of the unit root test performed by the CIPS panel and the causality test

conducted by the Emirmahmutolu and Kose, which was also used in this study, causality testing is permitted when the results of unit root tests are at both level and first differences. The estimation findings of the causality test conducted using Emirmahmutolu and Kose Panel test for causality to examine the causative association between capital investments in travel and tourism and the number of foreign tourist arrivals and the GDP income ratio are presented in tables 5, 6, and 7 below;

Table 5. Emirmahmutoğlu and Kose Panel Causality Test Results (lntg-lntn)

Countries	H_0: lntn ↛ lntg			H_0: lntg ↛ lntn		
	ki	wi	pi	ki	wi	pi
Brazil	4	395.025	0.000*	4	1.756	0.781
Russian Federation	4	8.568	0.073***	4	3.754	0.440
India	4	44.909	0.000*	4	2.502	0.644
China	3	2.582	0.461	3	4.632	0.201
South Africa	4	54.985	0.000*	4	13.382	0.010*
Model		478.118	0.000*		15.528	0.114
*, ** and *** Indicates that the null hypothesis is rejected at the 1% significance level, respectively						

The Emirmahmutolu and Köse Panel Causality test was used to examine the relationship between the number of international tourists' arrivals and the tourism income to GDP ratio in the article. The test results presented in Table 5 show the existence of a unidirectional causality each of the BRICS countries between the number of international tourism arrivals and the tourism income in GDP ratio and the results obtained have been proven in terms of TLG hypothesis. If test results are investigated in terms of countries, there was a unidirectional causality between the number of international tourism arrivals and the tourism income in GDP ratio for Brazil, Russian Federation, and South Africa. In contrast, India had a bidirectional causality nexus between the number of international tourism arrivals and the tourism income in GDP ratio, no causal nexus was found for China.

Table 6. Emirmahmutoğlu and Kose Panel Causality Test Results (lntg-lnti)

Countries	H_0: lnti ↛ lntg			H_0: lntg ↛ lnti		
	ki	wi	pi	ki	wi	pi
Brazil	4	7.831	0.098***	4	16.707	0.002*
Russian Federation	2	11.652	0.003*	2	0.235	0.889
India	2	1.437	0.487	2	0.296	0.862
China	2	11.570	0.003*	2	0.603	0.740
South Africa	2	8.160	0.017**	2	9.086	0.011**
Model		37.465	0.000*		22.456	0.013**
*, ** and *** Indicates that the null hypothesis is rejected at the 1% significance level, respectively						

The Emirmahmutolu and Köse Panel Causality test was used in the article to examine the relationship between capital investments in travel and tourism and the tourist income to GDP ratio. The test's findings, which are in line with the feedback hypothesis, are reported in Table 6. For all of the BRICS nations, there was a bidirectional causal relationship between capital investments in travel and tourism and the tourism income to GDP ratio.

If the results of analysis are investigated in terms of countries, there was a unidirectional causality from the capital investments in travel and tourism to the tourism income in GDP ratio for Russian Federation and China. In contrast, while Brazil and South Africa have a bidirectional causality nexus between the capital investments in travel and tourism and the tourism income in GDP ratio, no causal nexus was found for India.

Table 7. Emirmahmutoğlu and Kose Test Results for Panel Causality (lnti-lntn)

Countries	H_0: lnti ↛ lntn			H_0: lntn ↛ lnti		
	ki	wi	pi	ki	wi	pi
Brazil	2	14.580	0.001*	2	0.103	0.950
Russian Federation	1	0.477	0.788	1	0.826	0.662
India	2	0.628	0.730	2	0.133	0.936
China	2	0.425	0.514	2	2.289	0.130
South Africa	2	0.258	0.879	2	39.293	0.000*
Model		17.273	0.069***		44.431	0.000*
*, ** and *** Indicates that the null hypothesis is rejected at the 1% significance level, respectively						

The causality nexus between the capital investment in travel and tourism and the number of arrivals of international tourism was analyzed using the Emirmahmutoğlu and Köse test for panel causality. The bidirectional causality relationship between capital investments in travel and tourism and the number of foreign tourist arrivals was found for each of the BRICS nations, as evidenced by the causality test results provided in Table 7, and the findings supported the feedback hypothesis. If the results of analysis are investigated in terms of countries, there was a unidirectional causality between the capital investments in travel and tourism and the number of arrivals of international tourism for Brazil.

In contrast, South Africa had a unidirectional causality nexus between the number of arrivals of international tourists and capital investments in travel and tourism, no causal nexus was found for other countries. For countries where there was no relationship between the variables, the neutrality hypothesis held true.

According to the Emirmahmutoğlu and Köse Panel Causality test analysis presented in Figure 2 of the Appendix, a bidirectional causality relationship was identified between capital investments in travel and tourism, the number of international tourist arrivals, and the tourism income to GDP ratio. However, a unidirectional causality relationship was observed, with causality running from the number of international tourist arrivals to capital investments in travel and tourism.

CONCLUSION

In this article, the nexus between capita investments in travel and tourism, the number of international tourism arrivals and the tourism income in GDP ratio for all BRICS countries was investigated and reported using the Panel causality test. The analysis results can guide policy makers of countries with tourism potential for the development of the tourism sector. For instance, the bidirectional causality in Table 6 underscores the interplay between investments and tourism income, while Graph 1 highlights varying income trends across BRICS nations. Increased capital investments in travel and tourism and the number of international tourism arrivals, which is the financing source of the economic development of countries and creates an increase in tourism revenues would go a long way in ensuring macroeconomic stability. Tourism promoting policies towards BRICS countries should be implemented through augmentation in tourism investments, an increase in tourism revenues, which will have an indirect positive affect on economic growth, and capital investments in travelling sector. Thus, tourism would highly impact on overall economic growth.

If the country-based results of the study and policy recommendations are evaluated, policy makers should consider that the rise in the number of tourism arrivals to Brazil, Russian Federation, India, and South Africa may have a positive effect on the tourism income in GDP ratio. However, there was no correlation noted between the rise in the tourism income in GDP ratio and the number of international tourist arrivals for South Africa. Therefore, it is recommended that the political and economic decision makers of these countries, especially the Chinese government, consider implementing foreign tourist friendly measures in order to raise the number of international tourist arrivals.

While investigating the relationship between capital investments in travel and tourism and the tourism income in GDP ratio, for all BRICS countries except India, it was observed that the capital investment in travel and tourism caused the rise in the tourism income in GDP ratio. Thus, the sustainability of capital investments in current travel and tourism policies will be more effective for the increase in the ratio of tourism income in GDP. For Brazil and South Africa, the ratio of tourism income to GDP and capital investment in travel and tourism are causally related in both directions. The bidirectional causation relationship between capital investments in travel and tourism and the tourism income to GDP ratio demonstrates that sustainable economic growth policies in these nations also have a favorable impact on capital investments in travel and tourism. For Brazil, the direction of causality is between the capital investments in travel and tourism and the number of arrivals of international tourists and for South Africa, the direction of causality is the reverse. No correlation was found between the two variables in other countries.

Policymakers should first determine the investment capital in travel and tourism, and then make adjustments to the number of arrivals of international tourist policies for BRICS countries. A unidirectional causation nexus was found between the number of foreign tourist arrivals and the ratio of tourism income in GDP, while a bidirectional causality nexus was found between the ratio of tourism income in GDP and the capital investments in travel and tourism.

The positive effects of capital investment policies in travel and tourism for BRICS countries show that these policies can increase the number of international tourists and the share of tourism income in GDP. This suggests that countries should align their investment strategies with goals to boost tourism revenue. When these policies are tailored to a country's economic situation, they can become a strong financial tool to achieve desired economic results.

The study is *limited* by its reliance on the Emirmahmutoğlu and Köse Panel Causality Test, which, despite addressing heterogeneity and cross-sectional dependence, may be vulnerable to endogeneity and specification biases, potentially skewing results. The timeframe (1995–2020) excludes recent events like the COVID-19 pandemic, reducing relevance to current tourism trends. It also focuses solely on economic variables, neglecting social, cultural, and environmental factors critical to tourism in the diverse BRICS countries, while the panel approach may mask country-specific differences despite logarithmic data adjustments.

While our panel approach reveals general patterns, the diverse economic and political contexts of BRICS countries (Tables 5-7) caution against overgeneralization. Policies must be tailored to each nation's unique conditions.

Based on the causality results (Tables 5-7) and trends in Graph 1, we propose tailored policies for BRICS countries. For Brazil, where investments drive tourist arrivals (Table 7), investments in airport modernization and eco-tourism facilities, financed through public-private partnerships, could boost arrivals. South Africa, with bidirectional causality (Table 6), should prioritize hospitality upgrades and global marketing campaigns, supported by tax incentives. China, showing no causality in some cases (Table 5), could focus on cultural tourism infrastructure, such as heritage site enhancements, funded by tourism bonds. These targeted measures align with each country's economic conjuncture and tourism potential.

While our analysis focuses on economic outcomes (Tables 5-7), tourism's social and environmental impacts are equally vital in BRICS countries. The rise in tourist arrivals (Table 5) could exacerbate environmental pressures, such as resource depletion, unless offset by sustainable investments (e.g., renewable energy in tourism facilities). Conversely, increased tourism income (Graph 1) offers opportunities to fund social benefits, like local employment, and align with SDGs. Future research should integrate these dimensions to provide a holistic view of tourism development.

Appendix

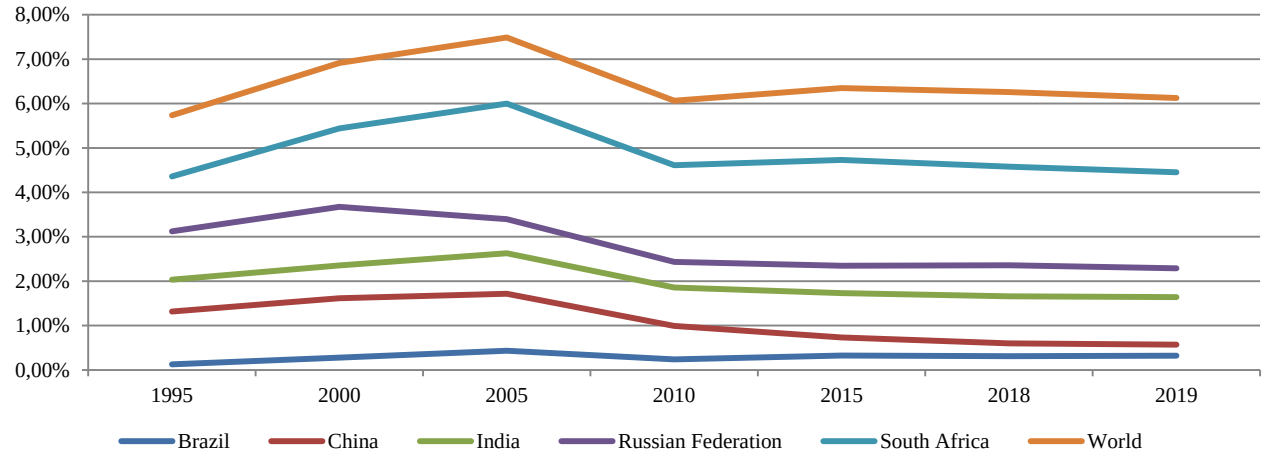

Figure 2. GDP ratio for the BRICS countries and the entire World

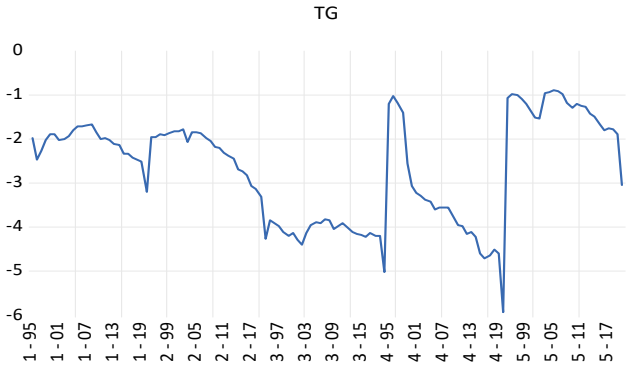

Figure 3. The constant CIPS test for unit roots results

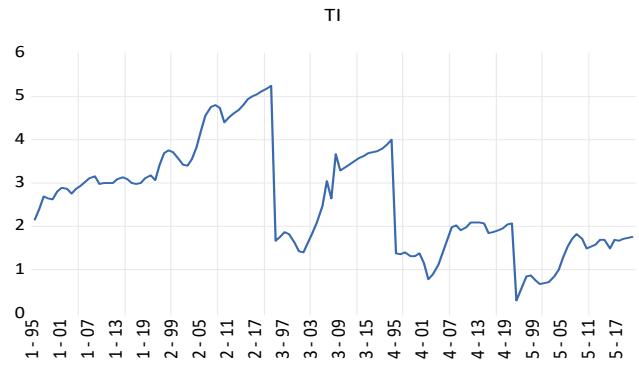

Figure 4. The constant CIPS test for unit roots results

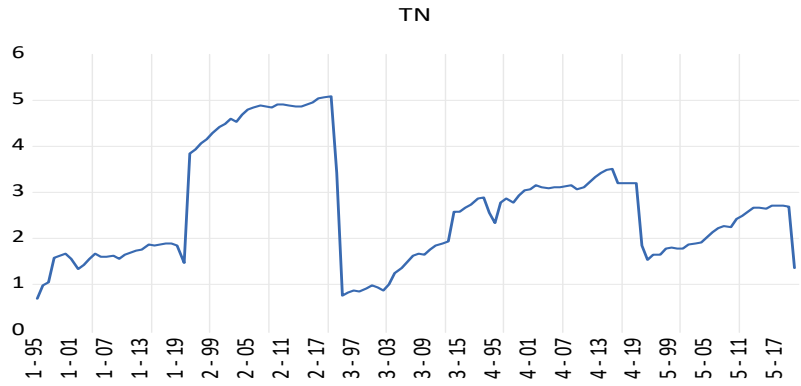

Figure 5. The constant CIPS test for unit roots results

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