

Research Article

Determinants of Economic Growth: The Role of Tourism, Trade Openness, Physical Capital, and Internet Use in the Case of BRICS Countries¹

Ekonomik Büyümenin Belirleyicileri: BRICS Ülkeleri Örneğinde Turizm, Ticari Açıklık, Fiziksel Sermaye ve İnternet Kullanımının Rolü

Mücahit ÜLGER Assist. Prof., Kırşehir Ahi Evrar University Mucur Vocational School mucahit.ulger@ahievran.edu.tr https://orcid.org/0000-0003-0300-099X	Mehmet UÇAR Assist. Prof., Nevşehir Hacı Bektaş Veli University Gülşehir Social Sciences Vocational School mehmet.ucar@nevsehir.edu.tr https://orcid.org/0000-0001-6078-7536	Mustafa KARAKUŞ Assoc. Prof., Ankara Hacı Bayram Veli University Faculty of Financial Sciences mustafa-karakus@hbm.edu.tr https://orcid.org/0000-0001-7207-6686
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Makale Geliş Tarihi	Makale Kabul Tarihi
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Abstract

This study aims to contribute to the debate on achieving the Sustainable Development Goals by examining the effects of tourism, trade openness, physical capital, and internet use on economic growth. Sustainable and inclusive economic growth lies at the heart of countries' priority policy agendas, particularly in relation to Goal 8 of the United Nations Sustainable Development Goals. Within this framework, countries seek to develop structural policies that support sustainable economic growth. Accordingly, this study empirically investigates the key determinants of economic growth in BRICS countries. For this purpose, tourism, trade openness, physical capital, and internet use were included in the analysis, using annual data covering the period 1995–2019. The Augmented Mean Group (AMG) estimator was employed because cross-sectional dependence was detected in the estimated model and the slope coefficients exhibited heterogeneity. This estimator offers an important methodological advantage by providing estimates for both the overall panel and individual cross-sectional units. The empirical findings varied between the overall panel and individual countries. Nevertheless, an assessment of the general pattern indicates that physical capital and internet use have statistically significant and positive effects on economic growth. By contrast, trade openness and tourism were found to have no statistically significant effect on economic growth. This finding demonstrates that the effects of these variables on economic growth are not universal but may vary depending on country-specific conditions. The results highlight the critical importance of

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considering country-specific dynamics when designing sustainable growth policies and prioritizing investments in digital infrastructure and physical capital.

Keywords: Economic Growth, Tourism, Physical Capital, Trade Openness, Internet Usage

Öz

Bu çalışma, turizm, ticari açıklık, fiziksel sermaye ve internet kullanımının ekonomik büyüme üzerindeki etkilerini inceleyerek Sürdürülebilir Kalkınma Amaçları'na ulaşılması konusundaki tartışmaya katkı sağlamayı amaçlamaktadır. Sürdürülebilir ve kapsayıcı ekonomik büyüme, başta BM Sürdürülebilir Kalkınma Amaçları'nın 8. hedefi olmak üzere ülkelerin öncelikli politika gündemlerinin merkezinde yer almaktadır. Bu çerçevede ülkeler, sürdürülebilir büyüme sürecini destekleyecek yapısal politikalar geliştirme arayışı içindedir. Mevcut çalışma, bu doğrultuda BRICS ülkelerinde ekonomik büyümenin temel belirleyicilerini ampirik olarak araştırmaktadır. Söz konusu amaç doğrultusunda turizm, ticari açıklık, fiziksel sermaye ve internet kullanımı değişkenleri analize dahil edilmiş; 1995-2019 dönemine ait yıllık veriler kullanılmıştır. Tahmin edilen modelin yatay kesit bağımlılığı içermesi ve değişkenlerin eğim katsayılarının heterojen bir yapı sergilemesi nedeniyle AMG (Augmented Mean Group) tahmincisi tercih edilmiştir. Bu tahminci, panelin tamamı için katsayı üretmesinin yanı sıra yatay kesit birimleri düzeyinde de tahmin yapılmasına olanak tanıması bakımından önemli bir metodolojik avantaj sunmaktadır. Ampirik bulgular hem panel genelinde hem de birim düzeyinde farklılıklar sergilemiş; bununla birlikte genel eğilim açısından değerlendirildiğinde, fiziksel sermaye ve internet kullanımının ekonomik büyümeyi anlamlı ve pozitif yönde etkilediği tespit edilmiştir. Öte yandan ticari açıklık ve turizm değişkenlerinin ekonomik büyüme üzerinde istatistiksel olarak anlamlı bir etki yaratmadığı belirlenmiştir. Bu bulgu, söz konusu değişkenlerin büyüme üzerindeki etkisinin evrensel bir nitelik taşımadığını ve ülkeye özgü koşullara bağlı olarak farklılaşabildiğini ortaya koymaktadır. Bu sonuçlar, sürdürülebilir büyüme politikalarının tasarımıyla ülkeye özgü dinamiklerin gözetilmesinin ve dijital altyapı ile fiziksel sermaye yatırımlarının önceliklendirilmesinin kritik bir önem taşıdığına işaret etmektedir.

Anahtar Kelimeler: Ekonomik Büyüme, Turizm, Fiziksel Sermaye, Ticari Açıklık, İnternet Kullanımı

1. INTRODUCTION

Today, sustainable development is regarded as an important approach that requires economic growth to be addressed together with its environmental and social dimensions. Accordingly, the Sustainable Development Goals (SDGs), adopted by the United Nations in 2015, established a global action plan to end poverty, protect the environment, and improve societal well-being. Comprising 17 goals in total, the SDGs treat economic, social, and environmental sustainability as complementary elements and emphasize that progress in one area can affect the others. Among these, Sustainable Development Goal 8 focuses specifically on supporting sustainable and inclusive economic growth and improving employment opportunities. Tourism stands out as one of the sectors that can contribute to achieving these goals. It is regarded as an important activity that allows individuals to relax, gain new experiences, learn about different cultures, strengthen inter-societal interaction, and broaden their worldview (Liulov et al., 2020). Tourism is also defined as a social and cultural phenomenon that contributes to economic growth and holds a significant share in global services trade (Curry et al., 2016). As one of the most dynamic elements of globalization, the tourism sector has shown a remarkable growth trend in recent years (Scott et al., 2019); indeed, the rising number of international tourists is considered a key indicator for evaluating the sector's development (Sánchez-Rivero & Pulido-Fernández, 2020).

Within the framework of sustainable economic growth, the literature indicates that the development of the tourism sector can provide various economic and social benefits, such as increased employment, improved transportation infrastructure, higher local incomes, and the preservation of cultural heritage (Shahzad et al., 2017). Tourism activities are therefore considered to contribute to the achievement of several sustainable development goals, primarily Sustainable Development Goal 8. Nevertheless, the effects of tourism on sustainable development may vary according to countries' economic structures, institutional characteristics, and development levels. In recent years, researchers have examined the links between tourism and sustainability more intensively, seeking to clarify the role of tourism in sustainable economic growth (Grilli et al., 2021). Examining the relationship between tourism and economic growth is thus important for developing policy recommendations aligned with the sustainable development goals. During the analysis period, the number of international tourists rose markedly across all BRICS countries: arrivals increased from 1.99 to 6.35 million in Brazil (approximately 219%), from 10.29 to 24.42 million in Russia (137%), from 2.12 to 17.91 million in India (743%), from 46.39 to

162.54 million in China (250%), and from 4.68 to 14.80 million in South Africa (216%) between 1995 and 2019.

One of the factors considered among the determinants of sustainable economic growth is physical capital. Traditional growth theories view physical capital as one of the fundamental determinants of economic growth and argue that capital accumulation can play a significant role in expanding production capacity (Bhattacharjee et al., 2022). In this context, physical capital encompasses investments made by the public, private, and general government sectors; it is considered an element that can contribute to increasing production capacity, supporting productivity, and sustainably promoting economic growth (Barro, 1991). Similarly, it is stated that physical capital is one of the fundamental determinants of economic growth and can support long-term development performance through investments (Ehigiamusoe et al., 2024). The relationship between physical capital and sustainable development is particularly important in terms of achieving sustainable economic growth under Sustainable Development Goal 8. Capital accumulation in infrastructure investments, production facilities, transportation networks, and technological equipment is thought to contribute to the expansion of economic activities and the emergence of productivity increases. In this respect, physical capital investments are considered one of the elements that can be effective in supporting sustainable economic growth. Therefore, examining the impact of capital accumulation on economic growth can contribute to a better understanding of the potential role of investment policies in achieving sustainable development goals.

Another factor considered among the determinants of sustainable economic growth is trade openness. In recent years, trade openness has been seen as a significant determinant of economic growth and is considered a fundamental component of economic policy design, especially in developing countries (Rani & Kumar, 2019). The liberalization of trade allows countries easier access to international markets, contributing to more efficient use of resources and the expansion of economic activities. Furthermore, it is stated that trade openness can enable countries to use resources more efficiently by introducing them to new knowledge, technology, and innovative practices, thus supporting the economic development process (Ciobanu, 2021).

The relationship between trade openness and sustainable development is particularly important in terms of promoting sustainable economic growth under Sustainable Development Goal 8. Trade openness is considered an important tool in strengthening the long-term economic performance of countries and achieving sustainable growth targets (Zaman et al., 2021). The acceleration of knowledge and technology transfer through international trade can contribute to increased productivity in production processes and enable the diversification of economic activities. Therefore, trade openness is considered one of the factors that can be effective in supporting sustainable economic growth. Another prominent element among the determinants of sustainable economic growth is internet usage. Internet usage is considered an important technological element that can increase economic efficiency and productivity by facilitating access to information, reducing communication costs, increasing market competition, and making commercial transactions more efficient (Yin & Choi, 2022). With the widespread adoption of digital technologies, the internet can accelerate interaction between individuals, firms, and public institutions, enabling economic activities to be carried out more effectively. Furthermore, it is stated that the development of internet infrastructure can support innovation and productivity by facilitating information sharing. The relationship between internet usage and sustainable development is particularly important in terms of promoting sustainable economic growth under Sustainable Development Goal 8. It is assessed that digitalization can have positive effects on economic growth because it increases the efficiency of economic activities, reduces transaction costs, and facilitates access to markets.

The research question of this study is to determine the extent and direction of the impact of tourism, physical capital, trade openness, and internet usage on economic growth in BRICS countries. Supporting economic growth under Sustainable Development Goal 8 remains a priority for policymakers, making it essential to identify the key drivers of economic performance. Although previous studies have extensively examined the effects of tourism, physical capital, trade openness, and digitalization on economic growth, these variables have generally been investigated separately or in different combinations. Consequently, the existing literature provides limited evidence on their simultaneous

effects within a unified empirical framework, particularly for the BRICS economies, where structural characteristics, development paths, and digital transformation processes differ substantially across countries. This represents an important research gap that the present study seeks to address. From a theoretical perspective, the four explanatory variables represent complementary channels through which economic growth can be influenced. Tourism stimulates economic activity by generating foreign exchange earnings, employment, and investment; physical capital enhances production capacity and productivity; trade openness facilitates technology transfer and resource allocation; while internet use promotes digital transformation, innovation, and production efficiency. Examining these variables simultaneously enables a more comprehensive assessment of the multiple mechanisms shaping economic growth than analyzing each determinant in isolation.

The aim of this study is to empirically examine the impacts of tourism, physical capital, trade openness, and internet usage on economic growth in BRICS countries using annual data covering the period 1995–2019. The BRICS countries were selected for this study because they constitute one of the most influential economic blocs in the global economy while exhibiting considerable heterogeneity in terms of economic growth performance, tourism potential, trade structures, and levels of digital transformation. Collectively, BRICS countries account for approximately 26% of the world's land area, 42% of the global population, 24% of global gross domestic product (GDP), 17% of world trade, and 13% of the global services market, highlighting their strategic importance in the international economy (Kalai et al., 2024). Moreover, projections suggest that the combined economic output of the BRICS economies will surpass that of the G7 countries by 2050, further reinforcing their growing role in shaping the global economic landscape (Anser et al., 2024). In addition to their increasing economic importance, BRICS countries differ considerably in their investment structures, trade integration, tourism development, and digitalization levels, providing a heterogeneous empirical setting for investigating whether the determinants of economic growth operate similarly or differently across member countries.

The study contributes to the literature in several respects. First, unlike many previous studies that focus on a single determinant or a limited set of explanatory variables, this study integrates tourism, physical capital, trade openness, and internet usage within a unified empirical framework to provide a more comprehensive explanation of economic growth. Second, it extends the existing literature by focusing on BRICS countries, whose structural heterogeneity allows country-specific dynamics to be identified. Third, the study employs the Augmented Mean Group (AMG) estimator, which accounts for both cross-sectional dependence and slope heterogeneity while providing panel- and country-specific long-run estimates. Accordingly, the findings contribute to a better understanding of the determinants of economic growth in emerging economies and provide policy implications tailored to the heterogeneous characteristics of BRICS countries.

The rest of the study is organized as follows: The second section includes the empirical literature on the subject. The third section explains the data set, model, and methodology. The fourth section provides the discussion, and the final section summarizes the results obtained and includes various policy recommendations.

2. LITERATURE REVIEW

In order to present the relevant literature in a more systematic and understandable way, existing studies have been addressed under four main headings: i) Relationship between Tourism and Economic Growth, ii) Relationship between Physical Capital and Economic Growth, iii) Relationship between Trade Openness and Economic Growth, and iv) Relationship between Internet Use and Economic Growth. This classification allows for a clearer understanding of the impact of each variable on economic growth. In addition, each heading has been divided into two subcategories according to the data structure used: panel data studies and time series studies. The main purpose of this division is to comparatively evaluate how different econometric approaches address these relationships and to reveal the extent to which the findings vary depending on methodological differences.

2.1. Relationship Between Tourism and Economic Growth

Among panel data studies, Rasool et al. (2021) used the panel ARDL cointegration test and Granger causality analysis in their study covering five BRICS countries for the period 1995–2015. According to the study findings, a long-term cointegration relationship was found between tourism, financial

development, and economic growth; a bidirectional causal relationship was revealed between incoming tourism and economic growth. Nyasha et al. (2021), in their study covering Sub-Saharan African countries for the period 2002-2018 and dividing the countries into two subgroups, low-income and middle-income, used the GMM method. According to the study findings, tourism expenditure negatively affects economic growth, while tourism revenues have a positive effect on economic growth. Usmani et al. (2021), in their study covering four developing countries consisting of Brazil, Russia, India, and China for the period 1995-2016, used the Dumitrescu-Hurlin causality test and panel data models. According to the study findings, tourist expenditures were found to have a positive and significant effect on economic growth, while the number of tourist arrivals did not have a significant effect on economic growth. Enilov and Wang (2022), in their study covering 23 developing and developed countries for the period January 1981-December 2017, used a bootstrap mixed frequency Granger causality approach supported by the sliding window technique and the global connectivity index (GCI). According to their findings, the causality relationship was found to be variable over time in both the short and long term; the tourism sector continued to be the primary determinant of economic growth in developing countries, while the growth effect from tourism in developed countries was found to be temporary. Albaladejo et al. (2023), in their study covering 144 countries for the period 1995-2019, used nonparametric clustering analysis, Granger causality test, and impulse response functions. According to their findings, the causality relationship from tourism to economic growth was confirmed only in the group of low-income countries with low tourism levels; these findings indicate that the tourism sector can function as a poverty escape route in low-income countries. Zheng et al. (2023), in their study covering BRICS countries for the period 1990-2020, used panel moment quantile regression analysis, Westerlund cointegration test, and Pesaran unit root test. According to their findings, tourism had a significant and positive impact on economic growth across all quantiles. Haini et al. (2024), in their study covering 143 economies for the period 1995-2017, used panel data analysis. Their findings indicated that social globalization positively impacted economic growth both directly and indirectly by strengthening international tourism; however, the direct impact of international tourism on economic growth in developing countries was found to be statistically insignificant. Seetanah and Fauzel (2025), in their study covering 28 small island economies for the period 1990-2019, used the panel ARDL (PARDL) model and panel Granger causality test. According to the study findings, the growth hypothesis led by tourism was confirmed in both the short and long term; It has been found that the impact of tourism on economic growth is conditioned by the level of digitalization, and that as digitalization increases, the economic benefits of tourism also increase.

In a time series study, El Menyari (2021) used the ARDL approach and Granger causality test in her study focusing on Morocco for the period 1983-2018. According to the study findings, the number of tourist arrivals had a positive effect on economic growth in the long term; the Granger causality test revealed a unidirectional causal relationship from economic growth to the number of tourist arrivals. Matthew et al. (2021), in their study focusing on Nigeria for the period 1980-2016, used FMOLS and the Johansen cointegration test. According to the study findings, tourism revenues had a significant and positive effect on economic growth; the interaction effect between tourism and foreign exchange earnings also positively impacted economic growth. Naseem (2021), in her study focusing on Saudi Arabia for the period 2003-2019, used the Johansen cointegration test and the Granger causality test. According to the study findings, a long-term relationship was found between economic growth and tourism revenues, tourism expenditures, and the number of tourists; the number of tourists showed a stronger relationship with economic growth compared to other tourism variables. Overall, the literature on the relationship between tourism and economic growth indicates that this relationship is mostly positive and significant, but that this effect can vary depending on conditional factors such as countries' income levels, regional characteristics, digitalization levels, and social globalization. Panel data studies show that tourism is a significant determinant of economic growth, especially in low-income and developing countries, while this effect is more limited and temporary in developed countries. Time series-based country-specific studies support the long-term positive impact of tourism revenues on growth and offer important insights to policymakers in developing integrated strategies for the tourism sector.

2.2. Relationship Between Physical Capital and Economic Growth

In panel data studies, Ding et al. (2021) used panel data analysis and quantile regression model in their study covering 143 countries and regions for the period 1990-2014. According to the study findings, the output elasticity of physical capital was found to be lower compared to human capital; it was concluded that the dependence on physical capital decreased as the level of economic development of countries increased.

In time series studies, Shah et al. (2020), in their study focusing on Pakistan for the period 1976-2015, used the Augmented Dickey-Fuller unit root test, Johansen cointegration test, VECM, and Granger causality test. According to the study findings, a long-term cointegration relationship was found between exports, imports, real GDP, and gross fixed capital formation; however, it was concluded that physical capital formation did not have a significant effect on GDP. Pomi et al. (2021), in their study focusing on Bangladesh for the period 2000-2019, used a Vector Autoregression Model (VAR). According to the study findings, physical capital was found to contribute to economic growth in different time dimensions; however, the effectiveness level of this contribution was found to be different from human capital. Bhattacharjee et al. (2022), in their study focusing on Bangladesh for the period 1990-2021, used the ARDL bounds test approach within the framework of the Cobb-Douglas production function. According to the study findings, gross fixed capital formation was found to have a significant and positive effect on economic growth in both the short and long term. Ishfaq et al. (2024), in their study focusing on Pakistan for the period 1971-2020, used unit root test, bounds test, and ARDL model. According to the study findings, physical capital was found to have a positive and statistically significant relationship with economic growth; it was concluded that capital formation is of critical importance for the development of the Pakistani economy. Atsu et al. (2025), in their study focusing on Indonesia for the period 1970-2023, used OLS estimation, Augmented Dickey-Fuller and Phillips-Perron unit root tests, and the Johansen cointegration test. According to the study findings, physical capital was found to have a positive effect on economic output.

Generally, while physical capital is seen to have a mostly positive effect on economic growth, this effect is not always statistically significant. Most time series-based country-specific studies show that physical capital formation positively supports growth, while a study on Pakistan found this effect to be insignificant, indicating that results can vary depending on country and period characteristics. Panel data analysis, from a broader perspective, points to the decreasing dependence on physical capital as the level of economic development increases, suggesting that this relationship may also vary depending on the stage of development.

2.3. Relationship Between Trade Openness and Economic Growth

Raghutla (2020), in her panel data study covering five BRICS countries (Brazil, Russia, India, China, and South Africa) for the period 1993-2016, used the Levin-Lin-Chu panel unit root test, Johansen-Fisher panel cointegration test, FMOLS method, and Dumitrescu-Hurlin heterogeneous panel causality test. According to the study findings, a long-term equilibrium relationship was found between trade openness and economic growth; it was determined that a 1% increase in trade openness increased economic growth by 0.186. Jalil and Rauf (2021), in their study covering 82 countries and five region-based subsamples for the period 1960-2019, used CCEMG and system-GMM estimators that take into account cross-sectional dependence, structural breaks, and endogeneity. According to the study findings, it was determined that trade openness positively affects economic growth; This result calls into question the empirical validity of previous studies suggesting that trade restrictions promote growth. Kong et al. (2021), in their study covering 30 provinces of China for the period 1994-2018, used the ARDL model, error correction model (ECM), Johansen cointegration test, and Hansen (1999) threshold regression model. According to the study findings, a long-term and stable cointegration relationship was found between trade openness and the quality of economic growth; trade openness significantly increased the quality of economic growth in both the short and long term, and this effect showed regional differences, and the existence of an "N-type" nonlinear threshold relationship between the two variables was determined. Dahmani et al. (2022), in their study covering 14 economic sectors of Tunisia for the period 1995-2018, used the Dumitrescu-Hurlin Granger causality test and the CS-ARDL model. According to the study findings, trade openness was determined to have a positive and significant effect on economic

growth. Osei-Assibey Bonsu and Wang (2022), in their study covering 45 countries for the period 1991-2014, used the dynamic seemingly unrelated regression (DSUR) model. According to their findings, a bidirectional relationship was found between trade openness and income in the long term. Mtar and Belazreg (2023), in their study covering 11 European countries for the period 2001-2016, used the panel VAR approach. According to their findings, a unidirectional causal relationship was found from trade to economic growth; a negative relationship was determined between trade and economic growth. Kumari and Singh (2024), in their study covering a total of 85 countries (27 low-income and 58 high-income) for the period 2000-2019, used OLS regression, fixed effects regression (FER), and GMM methods. According to their findings, trade openness positively affects economic growth in low-income countries, while the opposite is true in high-income countries.

In their time series studies, Islam et al. (2022) used ARDL cointegration regression and the Toda-Yamamoto Granger causality test in their study focusing on Saudi Arabia for the period 1985-2019. According to their findings, trade openness was found to positively contribute to economic growth in both the short and long term; the Toda-Yamamoto causality test results revealed a bidirectional causal relationship between trade openness and economic growth. Abdi et al. (2024), in their study focusing on Somalia for the period 1990-2020, used a nonlinear autoregressive distributed lag (NARDL) model and a vector error correction model (VECM). Their findings determined that a decrease in trade openness negatively impacted economic growth in the long term; causality analysis revealed a unidirectional relationship from trade openness to GDP in the short term, but this relationship was not observed in the long term.

Overall, both panel data and time series studies indicate that trade openness has a largely positive effect on economic growth. Panel data studies show that this relationship exhibits a stable cointegration structure in the long term and holds true for many country groups; however, the magnitude and direction of the effect can vary depending on countries' income levels, regional characteristics, and development levels. Country-specific time series studies, on the other hand, reveal that this relationship can exhibit different dynamics in the short and long term, and in some cases, diverge in terms of direction and significance. Therefore, the literature shows that while the relationship between trade openness and economic growth generally has a positive trend, it is also conditional and sensitive to country and period characteristics.

2.4. Relationship Between Internet Use and Economic Growth

In panel data studies, Billon et al. (2018), in a panel data analysis covering the period 1995-2010 and including 94 countries, found that internet use has a positive and significant effect on economic growth. However, the study revealed that this effect is shaped by educational inequality; in the disaggregation according to income levels, it was determined that internet use is positively related to economic growth, especially in middle and high-income countries. Li (2019), in his study covering 65 countries from the Belt and Road region in the period 1996-2014, using dynamic panel data analysis and R-type factor analysis, showed that the internet has a positive and statistically significant effect on economic growth, and that this effect strengthens with the development of the internet. Haftu (2019), in his analysis covering 40 Sub-Saharan African countries in the period 2006-2015 and conducted using the two-stage GMM method, found that the internet did not make a significant contribution to GDP per capita during the period examined. This finding has been attributed to the low level of technology penetration and the immature infrastructure conditions in the region. Wahab et al. (2020), in their panel ARDL (PMG) model-based analysis covering seven Southeast Asian countries for the period 1997-2013, found that internet use and trade positively and significantly affected economic growth. Yin and Choi (2022), in their panel vector autoregression (PVAR) study covering the period 1997-2017 and comparing East, South, and West Asian countries, revealed the existence of a unidirectional causal relationship from internet use to GDP in West Asia.

In time series studies, Bakari et al. (2020), focusing on Tunisia and covering the period 1985-2018, found in their ARDL bounds test approach that internet use stimulated economic growth in the short term but had a negative impact in the long term. This result is noteworthy in that it shows that the effect of the internet on growth can differ according to the time horizon.

Overall, panel data studies indicate that internet usage mostly has a positive impact on economic growth, but this effect can vary depending on countries' income levels, educational inequality, and regional characteristics. Time series-based country-specific studies, on the other hand, reveal that short-term and long-term dynamics can diverge, suggesting that the issue may be time-sensitive.

2.5. Research Gap and Contribution of the Study

Despite the growing body of literature examining the determinants of economic growth, several important research gaps remain. First, previous studies have generally investigated the effects of tourism, physical capital, trade openness, and internet use separately or by considering only a limited combination of these variables. Consequently, the interactive and complementary roles of these determinants in shaping economic growth have not been sufficiently explored within a unified empirical framework. Second, although numerous studies have focused on individual countries or broad country groups, empirical evidence for BRICS countries remains relatively limited despite their increasing importance in the global economy and their heterogeneous economic structures. Existing findings also reveal considerable inconsistencies regarding the effects of tourism and trade openness on economic growth, suggesting that these relationships may vary depending on country-specific characteristics, levels of development, and structural conditions. Finally, many previous studies have relied on conventional panel estimators that do not adequately account for cross-sectional dependence and slope heterogeneity, potentially affecting the reliability of long-run coefficient estimates.

This study seeks to address these gaps by simultaneously examining the effects of tourism, physical capital, trade openness, and internet use on economic growth in BRICS countries within a single empirical framework. Furthermore, the study employs the Augmented Mean Group (AMG) estimator, which explicitly considers cross-sectional dependence and heterogeneous slope coefficients while providing both panel-level and country-specific long-run estimates. Therefore, the study contributes to the existing literature by offering a more comprehensive understanding of the determinants of economic growth in BRICS countries and by providing policy implications that acknowledge the heterogeneous characteristics of these emerging economies.

3. METHODOLOGY AND EMPIRICAL FINDINGS

3.1. Model and Variable Definition

This study investigates the relationships between economic growth and tourism, physical capital, trade openness, and internet use in BRICS (Brazil, Russia, India, China, South Africa) countries. In this context, tourism, physical capital, trade openness, and internet usage rate were added to the model as independent variables. Due to data limitations, these relationships were investigated using annual data from the period 1995-2019. Although tourism, physical capital, trade openness, and internet use were selected based on theoretical and empirical considerations as key factors associated with economic growth, it should be acknowledged that economic growth is influenced by a broader set of factors. Variables such as human capital, financial development, institutional quality, and foreign direct investment have also been identified in the literature as important drivers of economic growth. These variables were not included in the empirical model in order to maintain model parsimony and to focus on the combined effects of the selected variables under a common analytical framework. Therefore, the estimated coefficients should be interpreted within the scope of the variables included in the model, and the omission of other potential determinants should be considered as a limitation of the study. Table 1 shows the details regarding the variables used.

Table 1: Explanations Regarding the Variables

Variable Names and Abbreviations	Explanation	Data source
Economic Growth (logGDP)	GDP per capita (constant 2015 US\$)	WDI
International Tourism, Number of Tourists Arriving (logTOA)	International tourism, number of arrivals	WDI
Physical Capital	Gross fixed capital formation (% of GDP)	WDI

(logGCF)		
Trade Openness	Trade (% of GDP)	WDI
(logTRD)		
Internet Usage	Individuals using the Internet (% of population)	WDI
(logINT)		

Note: World Development Indicators (WDI).

The model predicted in the study is as follows:

$$\log GDP_{i,t} = \beta_0 + \beta_1 \log TOA_{i,t} + \beta_2 \log GCF_{i,t} + \beta_3 \log TRD_{i,t} + \beta_4 \log INT_{i,t} + u_{i,t} \quad (1)$$

Logarithmic transformations were performed on the variables used. The independent variables in the model were selected based on theoretical and empirical approaches that reveal how economic growth is shaped through different channels. Tourism development is considered an important area of activity that can support economic growth by increasing foreign exchange earnings, creating employment, encouraging investments, and revitalizing the service sector. Considering the extensive natural, cultural, and economic attractions of the BRICS countries in particular, examining the impact of tourism on growth is of great importance. Physical capital was included in the model because it is one of the fundamental factors of production in increasing production capacity. Physical capital is proxied by gross fixed capital formation (GCF) as a percentage of GDP. Therefore, the variable captures capital formation rather than the stock of physical capital itself. Neoclassical and endogenous growth theories emphasize that capital accumulation supports economic growth by increasing productivity and production levels. The trade openness variable is based on the idea that international trade can affect growth by accelerating technology transfer, improving resource allocation, and increasing competitiveness. Given the increasing role of BRICS countries in global trade, analyzing the impact of openness on growth was deemed necessary. The internet usage rate was included in the model as an indicator representing the transformative effect of digitalization on economic activities. Internet use is measured by the percentage of individuals using the Internet. Accordingly, this indicator captures the extent of internet use rather than broader dimensions of digital transformation, digital infrastructure, or technological innovation. Information and communication technologies (ICTs) are generally considered to support economic growth because they facilitate access to information, reduce transaction costs, encourage innovation, and increase the efficiency of production processes. In particular, examining the impact of internet usage on growth in BRICS countries, where the digital economy is becoming increasingly important, contributes to a better understanding of economic transformation processes.

3.2. Method and Empirical Findings

One of the first steps in empirical analysis is the evaluation of summary statistics. Summary statistics are presented in Table 2.

Table 2: Summary Statistics

Variables	Observation Result	Mean	Standard Deviation	Min.	Max.
logGDP	125	3.627	0.350	2.792	4.015
logTOA	125	7.144	0.536	6.299	8.210
logGCF	125	1.365	0.147	1.146	1.644
logTRD	125	1.601	0.153	1.194	1.841
logINT	125	0.880	0.924	-2.305	1.917

As shown in Table 2, the number of observations is 125. This number of observations is sufficient for panel data analysis. The highest value, 8.210, belongs to the tourism variable. The minimum value, -2.305, belongs to the internet usage variable. Table 3 presents the correlation matrix.

Table 3: Correlation Matrix

	logGDP	logTOA	logGCF	logTRD	logINT
logGDP	1				
logTOA	0.287	1			
logGCF	-0.412	0.568	1		
logTRD	0.077	0.487	0.094	1	
logINT	0.627	0.279	-0.064	0.285	1

The correlation matrix investigates the suitability of the variables in the model for econometric analysis. As can be seen in Table 3, there is no relationship between the variables at a level that would prevent the analysis (>0.80).

One of the most important diagnostic tests in panel data analysis is cross-sectional dependence. The model to be used is determined based on this. In this study, cross-sectional dependence was investigated using the Breusch and Pagan "CDLM" test. For the test to be usable, the cross-sectional dimension must be smaller than the time dimension ($N < T$) (Breusch & Pagan, 1980; Pesaran, 2004). Since the present panel consists of five countries observed over 25 years ($N=5$ and $T=25$), the Breusch–Pagan LM statistic was taken as the primary criterion for evaluating cross-sectional dependence. The CDLM test statistic equation is as follows:

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

In the equation, P_{ij} is used to represent the sample estimate of the pairwise correlation coefficients of the error terms. e_{it} is obtained from the OLS estimation of the error terms.

The second diagnostic test, important for panel data analysis, is determining the homogeneity of the slope coefficients. For this purpose, the Delta test proposed by Pesaran and Yamagata (2008) was used. This test was developed by Swamy (1970). This method calculates two different test statistics: Δ and Δ_{adj} . The equations for these statistics are as follows:

$$\Delta = \sqrt{N} \left(\frac{N^{-1} \tilde{S} - k}{\sqrt{2k}} \right) \quad (3)$$

$$\Delta_{adj} = \sqrt{N} \left(\frac{N^{-1} E(\tilde{Z}_{iT})}{\sqrt{\text{var} \tilde{Z}_{iT}}} \right) \quad (4)$$

Table 4 shows the results for cross-sectional dependence and homogeneity.

Table 4: Cross-Sectional Dependence and Homogeneity Test Results

CD Test		
Test	Statistics	p-value
LM	24.32	0.006***
LMadj.	6.894	0.000***
LMCD	0.715	0.474
Homogeneity Test		
	Delta	p-value
	8.852	0.000***
Adj.	10.154	0.000***

Note: *, ** and *** represent significance level at 10, 5 and 1% respectively.

The statistics in the first part of Table 4 relate to cross-sectional dependence. The tests provide somewhat different evidence regarding cross-sectional dependence: the LM and LM-adjusted statistics reject the null hypothesis of no cross-sectional dependence, whereas the LMCD statistic does not. Given the small cross-sectional dimension relative to the time dimension ($N=5 < T=25$), the Breusch–Pagan LM statistic was taken as the primary criterion. Based on its p-value ($p=0.006$), the null hypothesis of no cross-sectional dependence was rejected. Accordingly, the subsequent analysis proceeds by allowing for cross-sectional dependence. In the homogeneity test results, it was concluded that the slope coefficients of the delta and deltaadj. statistics are heterogeneous according to the p-value.

In panel data analysis, the unit root test to be applied to the variables varies depending on the presence of cross-sectional dependence. The stationarity of the series affects the consistency and reliability of the coefficients of the estimated models. Since the estimated model in this study contains cross-sectional dependence, a second-generation unit root test was used. The Cross-Sectional Augmented Dickey-Fuller (CADF) test developed by Pesaran (2007) was applied. The CADF test is based on the traditional Augmented Dickey-Fuller (ADF) test. However, it is created by adding the lagged values of the cross-sectional means and the first differences of these means to the model for the series specific to each cross-section. This allows the cross-sectional dependence problem that arises in panel data analyses to be taken into account and also produces more reliable results (Pesaran, 2007).

$$\Delta y_{it} = \mu_i + \omega_i t + \alpha_i y_{i,t-1} + v_i \bar{y}_{t-1} + \sum_{j=1}^{P_i} \lambda_{ij} \Delta y_{i,t-j} + \sum_{j=0}^{P_i} \bar{\omega}_{ij} \Delta \bar{y}_{t-j} + \varepsilon_{it} \quad (5)$$

Table 5 shows the CADF unit root test results.

Table 5: CADF Unit Root Test Results

Variables	Constant		Constant + Trend	
	Statistics	p-val.	Statistics	p-val.
LogGDP	-1.077	0.141	-1.819	0.034**
LogTOA	-0.613	0.270	0.699	0.758
Δ LogTOA	-2.053	0.020**	-0.890	0.187
LogGCF	-0.712	0.238	-1.825	0.034**
LogTRD	-0.277	0.391	-0.784	0.216
Δ logTRD	-2.581	0.005***	-1.175	0.120
LogINT	-1.170	0.121	-2.501	0.006***

Note: *, ** and *** represent significance level at 10, 5 and 1% respectively.

When the unit root test statistics are evaluated in Table 5, it is observed that the dependent variable, economic growth, physical capital, and internet use are stationary at the I(0) level, while tourism and trade openness are stationary at the I(1) level.

After determining the stationarity levels of the variables, the cointegration relationship between the variables was investigated. The cointegration relationship was investigated with the test developed by Westerlund (2008). This test was investigated with the "Durbin-Hausman" (DH) test, which has an advantage compared to panel cointegration methods. The prerequisite for using this test is that there is at least one unit root in the model (Westerlund, 2008). Table 6 presents the cointegration test results.

Table 6: Cointegration Test Results

Statistics	Avg. Statistics	Z-value	p-value
DHg	23.609	6.661	0.000***
DHp	5.540	3.429	0.000***

Note: *** Represents significance at the 1% level. (Critical Values; 10%: 1.281, 5%: 1.644; 1%: 2.326)

According to the test findings in Table 6, both group (DHg) and panel (DHp) statistics are statistically significant at the 1% significance level. This finding indicates the existence of a long-term relationship across the panel among the variables in the model. With the establishment of a cointegration relationship between the variables, long-term coefficient estimation was initiated.

The model estimated in this study includes cross-sectional dependence. In this context, estimators that consider the heterogeneity and cross-sectional dependence of slope coefficients in panel data analysis are crucial for the consistency of results. Accordingly, it was decided to use the Augmented Mean Group (AMG) estimator developed by Eberhardt and Bond (2009) and Eberhardt and Teal (2010) in this study. The AMG method follows a two-stage process. In the first stage, a pooled regression in first differences augmented with year dummies is estimated. The coefficients on the year dummies are used to capture the unobserved common dynamic process shared across the cross-sectional units. In the second stage,

this estimated common dynamic process is incorporated into the country-specific level regressions, which are estimated separately for each cross-sectional unit. The country-specific slope coefficients are then averaged to obtain the AMG panel estimates. The AMG estimator was preferred because the preliminary diagnostic tests indicated the presence of both cross-sectional dependence and slope heterogeneity, making conventional panel estimators such as pooled OLS, fixed effects (FE), and random effects (RE) inappropriate. AMG accounts for unobserved common factors while allowing slope coefficients to vary across countries, thereby providing reliable long-run panel- and country-specific estimates. Although alternative second-generation estimators, such as the Common Correlated Effects Mean Group (CCEMG) estimator, could also be employed, AMG was considered more appropriate for the objectives of this study. However, while AMG addresses cross-sectional dependence and heterogeneity, it does not completely eliminate potential endogeneity arising from reverse causality, particularly between economic growth and internet use. Therefore, the estimated coefficients should be interpreted as long-run associations rather than strict causal effects. Future studies may further examine the robustness of these findings using alternative estimators, such as CCEMG, System GMM, or instrumental variable approaches. The equation for the AMG estimator is as follows:

$$y_{it} = \alpha_i + \beta_i x_{it} + \lambda_t + \varepsilon_{it} \quad (6)$$

Here, y_{it} represents the dependent variable, x_{it} the independent variable vector, α_i the cross-sectional constants, β_i the unit-specific slope coefficients, λ_t the common temporal effects, and ε_{it} the error term. With this structure, the AMG estimator provides more reliable results by considering both common factors and structural differences between units in the panel data. Table 7 shows the AMG test results.

Table 7: AMG Test Results

<i>Panel Results</i>			
Variables	Coefficient	Std. Error	P-val.
LogTOA	-0.036	0.064	0.575
LogGCF	0.324	0.084	0.000***
LogTRD	-0.058	0.079	0.465
LogINT	0.044	0.013	0.001***
Sabit	3.353	0.412	0.000***
<i>Horizontal Section Results</i>			
<i>Brazil</i>			
LogTOA	0.019	0.010	0.079*
LogGCF	0.379	0.017	0.000***
LogTRD	-0.058	0.015	0.000***
LogINT	0.010	0.003	0.002***
Sabit	3.288	0.087	0.000***
<i>Russia</i>			
LogTOA	-0.030	0.070	0.667
LogGCF	0.524	0.142	0.000***
LogTRD	0.129	0.127	0.309
LogINT	0.089	0.016	0.000***
Sabit	3.041	0.712	0.000***
<i>India</i>			
LogTOA	0.064	0.042	0.123
LogGCF	0.014	0.106	0.892
LogTRD	-0.233	0.065	0.000***
LogINT	0.035	0.007	0.000***
Sabit	2.741	0.334	0.000***
<i>China</i>			
LogTOA	0.052	0.079	0.514
LogGCF	0.332	0.103	0.000***
LogTRD	-0.238	0.030	0.000***
LogINT	0.033	0.007	0.000***

Sabit	2.742	0.688	0.000***
<i>South Africa</i>			
LogTOA	-0.287	0.100	0.004***
LogGCF	0.372	0.081	0.000***
LogTRD	0.109	0.069	0.113
LogINT	0.054	0.017	0.000***
Sabit	4.935	0.648	0.000***

Note: *, ** and *** represent significance level at 10, 5 and 1% respectively.

When the panel results are evaluated from the statistics in Table 7, it is concluded that the variables of tourism and trade openness are not statistically significant. This finding suggests that the long-run relationships of tourism and trade openness with economic growth vary across BRICS countries, while their average associations are not statistically significant at the panel level. These differences may be related to country-specific characteristics, such as economic structures, export composition, and the relative importance of the tourism sector, although these mechanisms are not directly tested in the present model. A 1% relative increase in GCF (gross fixed capital formation as a percentage of GDP), used as a proxy for physical capital, is associated with a 0.324% increase in economic growth. Since the model is specified in logarithmic form, this represents a 1% relative change in the physical capital indicator rather than a one-percentage-point increase in the physical capital-to-GDP ratio. This elasticity indicates a positive long-run association between physical capital and economic growth. Broader mechanisms related to productive capacity, infrastructure, and productivity may provide possible explanations for this relationship in light of the relevant literature; however, these mechanisms are not directly measured or tested in the present study. Similarly, a 1% relative increase in the share of individuals using the Internet is associated with a 0.044% increase in economic growth; this should not be interpreted as a one-percentage-point increase in the internet-use rate. Although the magnitude of the coefficient is relatively small, the result indicates a positive long-run association between the share of individuals using the Internet and economic growth. Broader mechanisms related to digitalization, transaction costs, and production efficiency may help explain this relationship, but they are not directly tested in the present model.

Looking at the cross-sectional results, all variables are statistically significant in Brazil. While trade openness exhibits a negative and statistically significant long-run association with economic growth, tourism, physical capital, and internet use exhibit positive and statistically significant long-run associations. A 1% increase in trade openness is associated with a 0.058% decrease in economic growth. This negative association may be related to country-specific characteristics, such as dependence on imported intermediate goods or export composition; however, these mechanisms are not directly tested in the present model. In contrast, a 1% relative increase in tourism, physical capital, and internet use is associated with changes in economic growth of 0.019%, 0.379%, and 0.010%, respectively. For physical capital and internet use, these interpretations refer to relative percentage changes in the underlying indicators rather than percentage-point changes. These results indicate positive long-run associations of tourism, physical capital, and internet use with Brazil's economic growth. Broader mechanisms involving investment, tourism activities, and digitalization may provide possible explanations for these relationships in light of the relevant literature, but they are not directly tested in this study.

In Russia, the tourism and trade openness variables were not found to be statistically significant. These statistically insignificant coefficients should not be interpreted as evidence that tourism or trade openness is economically unimportant for Russia. Country-specific characteristics, including the role of resource-based industries and other structural factors, may help explain the observed results; however, such mechanisms are not directly examined in the present model. A 1% relative increase in physical capital, used as a proxy for physical capital, is associated with a 0.524% increase in economic growth. This relatively large elasticity indicates a positive and statistically significant long-run association between physical capital and economic growth rather than establishing capital accumulation as a causal driver of growth. A 1% relative increase in the share of individuals using the Internet is associated with a 0.089% increase in economic growth. This finding indicates a positive and statistically significant long-run association between the share of individuals using the Internet and economic growth. As noted above, these percentage changes in physical capital and internet use should not be interpreted as

percentage-point changes in the respective indicators. Broader mechanisms related to digital infrastructure and productivity may provide possible explanations in light of the relevant literature, but they are not directly measured or tested in this study.

In India, tourism and physical capital are not statistically significant. The statistical insignificance of these coefficients does not imply that tourism or capital formation is economically unimportant for India. A 1% increase in trade openness is associated with a 0.233% decrease in economic growth. This negative long-run association may be related to factors such as import dependence or the composition of foreign trade; however, these possible mechanisms are not directly tested in the present model. A 1% relative increase in the share of individuals using the Internet is associated with a 0.035% increase in economic growth, indicating a positive and statistically significant long-run association between the share of individuals using the Internet and economic growth. Broader developments related to the digital economy and digital transformation may offer possible explanations for this relationship in light of the relevant literature, but these mechanisms are not directly captured by the internet-use indicator employed in this study.

In China, only the tourism variable is statistically insignificant; this result should not be interpreted as evidence that tourism is economically unimportant. A 1% relative increase in physical capital is associated with a 0.332% increase in economic growth, indicating a positive and statistically significant long-run association. This relationship may be considered in light of the literature on China's investment-oriented development pattern, although specific investment channels are not directly examined in the present model. A 1% increase in trade openness is associated with a 0.238% decrease in economic growth. This negative long-run association may be related to external uncertainties or changes in the composition and structure of China's economy and trade; however, these mechanisms are not directly tested in this study. A 1% relative increase in the share of individuals using the Internet is associated with a 0.033% increase in economic growth, indicating a positive and statistically significant long-run association. Broader mechanisms involving digitalization, innovation, and productivity may provide possible explanations for this relationship, but they are not directly measured or tested by the model.

Finally, in South Africa, the trade openness variable is statistically insignificant. This statistical insignificance should not be interpreted as evidence that trade openness is economically unimportant or that trade expansion is insufficient to support economic growth. A 1% increase in tourism is associated with a 0.287% decrease in economic growth, indicating a negative and statistically significant long-run association. This relationship may be related to the vulnerability of tourism to external shocks or its linkages with other sectors, as suggested by the relevant literature; however, these mechanisms are not directly tested in the present model. A 1% relative increase in physical capital is associated with a 0.372% increase in economic growth, indicating a positive and statistically significant long-run association rather than directly demonstrating the effect of investment on productive capacity. A 1% relative increase in the share of individuals using the Internet is associated with a 0.054% increase in economic growth, indicating a positive and statistically significant long-run association between the share of individuals using the Internet and economic growth. These estimates represent elasticities and therefore refer to relative percentage changes in physical capital and internet use, not percentage-point changes in their original ratios. Broader mechanisms related to digital infrastructure and digitalization may help explain this relationship, but they are not directly measured or tested in the present study.

4. DISCUSSION

Examining the panel findings obtained from the AMG estimator, it is seen that physical capital and internet use exhibit positive and statistically significant long-run associations with economic growth, while trade openness and tourism remain statistically insignificant. The positive long-run association between physical capital and economic growth is consistent with the findings of many studies in the literature. Bhattacharjee et al. (2022) showed that gross fixed capital formation significantly increased economic growth in both the short and long term. Similarly, Ishfaq et al. (2024) and Atsu et al. (2025) also found that physical capital has positive effects on growth. In this context, the findings support the idea that capital accumulation is one of the fundamental determinants of economic growth. For BRICS countries, this finding can be attributed to their continued reliance on investment-driven growth strategies. The positive long-run association between gross fixed capital formation (GCF), used as a

proxy for physical capital, and economic growth may be related to broader mechanisms involving productive capacity and productivity, as suggested by the relevant literature. However, specific investment categories, such as infrastructure, manufacturing, transportation, and energy, are not directly measured in the present model. Despite differences in institutional structures and development levels, the findings indicate that physical capital exhibits a positive and statistically significant long-run association with economic growth across BRICS economies.

The finding that internet use positively affects growth is consistent with the results obtained by Li (2019) and Wahab et al. (2020). Both studies showed that internet use has a positive and significant effect on economic growth. This finding indicates that investments in digital infrastructure are an important tool supporting economic growth. The result is particularly meaningful for BRICS countries, where digital transformation has accelerated considerably over the last two decades. Expanding internet access has facilitated digital entrepreneurship, e-commerce, financial inclusion, and technological innovation while improving productivity across various sectors. Consequently, internet diffusion has become an increasingly important determinant of economic performance in these emerging economies.

On the other hand, the finding that trade openness is statistically insignificant does not align with most studies in the literature. Indeed, Raghutla (2020) showed that a 1% increase in trade openness increased economic growth by 0.186%, and Jalil and Rauf (2021) found that trade openness positively affected economic growth. Similarly, Islam et al. (2022) found that trade openness made a significant contribution to economic growth in both the short and long term. Therefore, it is considered that the effect of trade openness on growth is not valid for every country and period, but has a conditional nature. A possible explanation for this result is the substantial structural heterogeneity among BRICS countries. Although all member countries are highly integrated into international trade, they differ considerably in export composition, industrial competitiveness, technological capability, and dependence on commodity exports. These differences may weaken the average panel effect of trade openness. Furthermore, the growth effects of trade openness are often conditional upon complementary factors such as institutional quality, human capital, innovation capacity, and financial development. In the absence of these supporting conditions, greater trade openness may not necessarily translate into higher economic growth.

The finding that tourism is statistically insignificant also aligns with some studies in the literature. Haini et al. (2024) found that the direct effect of international tourism on economic growth in developing countries is not significant, while Albaladejo et al. (2023) showed that the causal relationship from tourism to growth is valid only in certain country groups. This situation shows that tourism's contribution to economic growth is not universal and is shaped by conditional factors such as the level of tourism development, income level, and digitalization of countries. For BRICS countries, the insignificant effect may also reflect differences in the economic importance of the tourism sector across member states. While tourism constitutes a major source of income in some BRICS economies, others rely primarily on manufacturing, natural resources, or industrial production as their main growth drivers. Consequently, tourism may not exert a sufficiently strong average effect on economic growth at the panel level. Moreover, external shocks affecting international tourism demand and differences in tourism infrastructure and institutional capacity may further reduce the aggregate contribution of tourism to economic growth.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examines the long-run relationships between economic growth and tourism, physical capital, trade openness, and internet use in BRICS countries (Brazil, Russia, India, China, and South Africa). Economic growth is used as the dependent variable, while tourism, physical capital, trade openness, and internet use are included as explanatory variables. These relationships were examined using annual data from 1995-2019. It was found that the estimated model exhibited cross-sectional dependence. Furthermore, heterogeneous slope coefficients were observed. Therefore, it was decided to use the AMG estimator. This estimator also produces results for cross-sectional units. According to the panel findings obtained from the AMG estimator, trade openness and tourism variables are statistically insignificant. In contrast, physical capital and internet usage variables positively affect growth. When cross-sectional findings are evaluated, in Brazil, the trade openness variable negatively affects economic growth, while

other variables positively affect growth. In Russia, tourism and trade openness variables are statistically insignificant. Physical capital and internet usage increase economic growth. In India, tourism and physical capital variables are insignificant. Trade openness negatively impacts growth, while internet usage has a positive impact. In China, only the tourism variable is insignificant. Trade openness has a negative coefficient, while physical capital and internet usage have positive coefficients. In South Africa, trade openness is insignificant. Tourism has a negative coefficient on economic growth, while physical capital and internet usage have positive coefficients. The panel results indicate positive and statistically significant long-run associations between economic growth and both gross fixed capital formation and internet use. These indicators represent capital formation and the prevalence of internet use, respectively, rather than directly measuring the physical capital stock or broader digital transformation processes. The positive and significant coefficient of the physical capital variable indicates that investment expenditures support growth by expanding production capacity. This result can be explained by the fact that industrialization, infrastructure investments, and policies aimed at increasing production capacity have been central to economic development strategies for many years in a significant number of BRICS countries. Similarly, the positive impact of internet usage on economic growth can be attributed to digital technologies making production processes more efficient, facilitating access to information, and increasing the effectiveness of economic activities. The empirical findings suggest that policies promoting productive investment and digital transformation may contribute to long-run economic growth in BRICS countries, as physical capital and internet use are the only variables found to have statistically significant positive effects at the panel level. However, given the structural heterogeneity of BRICS economies, the effectiveness of these policies is likely to differ across countries and should therefore be implemented in accordance with national economic priorities.

When country-specific results are examined, it is seen that in Brazil, tourism, physical capital, and internet usage support economic growth. The positive impact of tourism, in particular, can be attributed to the contribution of the country's natural and cultural resources to economic activities. Conversely, the negative impact of trade openness can be explained by the pressures experienced by import-dependent sectors against foreign competition or the fragility in the foreign trade balance. Consistent with the empirical finding that trade openness has a negative effect on economic growth, Brazil may benefit from policies aimed at improving the technological content of exports, strengthening domestic production capacity, and increasing export competitiveness rather than focusing solely on expanding trade volume. In Russia, the main determinants of economic growth are capital accumulation and internet usage. The insignificant impact of tourism and trade openness may stem from the fact that economic growth is more focused on the energy sector and investment. Since physical capital and internet use are identified as the main drivers of economic growth, policies supporting productive investment and further digitalization may contribute to sustaining long-term growth performance in Russia. Furthermore, applications that increase the integration of digital technologies into the industrial and service sectors can support productivity increases. In India, the positive impact of internet usage on growth is consistent with the accelerated digitalization process in recent years. Conversely, the negative impact of trade openness may be related to the pressure that foreign trade puts on domestic production in some sectors or the increase in import dependence. The insignificant findings for tourism and physical capital variables suggest that growth is primarily driven by dynamics stemming from the service sector and the digital economy. Given the positive contribution of internet use and the negative coefficient of trade openness, policies promoting digital innovation together with greater participation in high value-added export sectors may support India's long-run economic growth.

In China, the growth-enhancing effect of physical capital and internet usage is consistent with the country's investment-oriented development model and technology-based transformation process. The insignificant finding of the tourism variable may stem from the fact that economic growth is primarily driven by the industrial, manufacturing, and technology sectors. The negative impact of trade openness can be attributed to fluctuations in global trade conditions, dependence on external demand, or external competitive pressures. Consistent with the positive effects of physical capital and internet use, maintaining investments in high-technology industries while strengthening domestic demand may contribute to a more balanced and resilient growth pattern. In South Africa, the insignificant finding of trade openness indicates that changes in foreign trade volume do not directly reflect on economic growth. In contrast, the effects of other variables suggest that growth is fueled by elements such as

investment, tourism, and digitalization. The empirical findings suggest that improving the investment climate and expanding digital infrastructure may support the diversification of economic activities and strengthen long-term economic performance in South Africa. Overall, the empirical findings indicate that capital accumulation and internet use constitute the most consistent determinants of economic growth across the BRICS countries included in this study. By contrast, the effects of tourism development and trade openness vary across countries, suggesting that these relationships depend on national economic structures and institutional conditions. Accordingly, the findings do not support a uniform policy framework for all BRICS countries. Instead, country-specific policy strategies may be more appropriate. While productive investment and digital transformation emerge as common policy priorities, tourism and trade policies are likely to be more effective when designed in accordance with each country's production structure, export composition, institutional capacity, and level of economic development. These policy implications should be interpreted within the scope of the empirical findings and the limitations of the study rather than as universally applicable recommendations.

This study has several limitations that should be acknowledged when interpreting the findings. First, the empirical analysis is limited to the five BRICS countries and the period 1995–2019; therefore, the results may not be directly generalizable to other country groups with different institutional, economic, and social characteristics. Second, the model focuses on four key factors associated with economic growth -tourism, physical capital, trade openness, and internet use- while other important factors, such as human capital, financial development, institutional quality, and foreign direct investment, are not incorporated into the empirical framework. Consequently, the estimated relationships should be interpreted within the scope of the variables included in the model. Third, the study employs a linear long-run estimation approach; therefore, potential nonlinear relationships, threshold effects, and interaction mechanisms among the variables are beyond the scope of the present analysis. Fourth, although the AMG estimator accounts for cross-sectional dependence and slope heterogeneity, it does not fully address potential endogeneity and reverse causality. Therefore, the estimated coefficients should be interpreted as long-run associations rather than strict causal effects. These limitations also provide several avenues for future research. Future studies may examine whether the findings can be generalized to other developed and developing country groups by employing broader international samples. In addition, considering the heterogeneous effects observed across countries, future research could investigate threshold values and nonlinear dynamics between tourism, trade openness, and economic growth using nonlinear econometric approaches. Furthermore, incorporating variables such as institutional quality, financial development, human capital, and foreign direct investment into extended empirical models may provide a more comprehensive understanding of the factors associated with economic growth and their interrelationships.

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Araştırma Makalesi

Determinants of Economic Growth: The Role of Tourism, Trade Openness, Physical Capital, and Internet Use in the Case of BRICS Countries¹

Ekonomik Büyümenin Belirleyicileri: BRICS Ülkeleri Örneğinde Turizm, Ticari Açıklık, Fiziksel Sermaye ve İnternet Kullanımının Rolü

Mücahit ÜLGER Assist. Prof., Kırşehir Ahi Evrar University Mucur Vocational School mucahit.ulger@ahievran.edu.tr https://orcid.org/0000-0003-0300-099X	Mehmet UÇAR Assist. Prof., Nevşehir Hacı Bektaş Veli University Gülşehir Social Sciences Vocational School mehmet.ucar@nevsehir.edu.tr https://orcid.org/0000-0001-6078-7536	Mustafa KARAKUŞ Assoc. Prof., Ankara Hacı Bayram Veli University Faculty of Financial Sciences mustafa-karakus@hbv.edu.tr https://orcid.org/0000-0001-7207-6686
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Araştırma Makalesi

Ekonomik Büyümenin Belirleyicileri: BRICS Ülkeleri Örneğinde Turizm, Ticari Açıklık, Fiziksel Sermaye ve İnternet Kullanımının Rolü

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Genişletilmiş Özet

1. Giriş

Sürdürülebilir Kalkınma Amaçları (SKA), ekonomik, sosyal ve çevresel boyutları bütüncül bir şekilde ele alarak ülkelerin uzun dönemli kalkınma hedeflerine ulaşmalarını amaçlamaktadır. Bu kapsamda Sürdürülebilir Kalkınma Amacı 8, sürdürülebilir ve kapsayıcı ekonomik büyümenin desteklenmesine odaklanmaktadır. Ekonomik büyümenin belirleyicilerinin ortaya konulması, söz konusu hedeflerin gerçekleştirilmesi açısından önem taşımaktadır. Turizm, fiziksel sermaye, ticari açıklık ve internet kullanımı ekonomik büyümenin temel belirleyicileri arasında yer almaktadır. Turizm faaliyetleri döviz gelirleri, istihdam ve yatırım olanakları aracılığıyla ekonomik performansı etkileyebilirken, fiziksel sermaye üretim kapasitesinin ve verimliliğin artırılmasına katkı sağlayabilmektedir. Benzer şekilde ticari açıklık, kaynakların daha etkin kullanımına ve teknoloji transferine olanak tanırken, internet

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kullanımının yaygınlaşması ekonomik etkinliği ve üretkenliği destekleyebilmektedir. Bu nedenle söz konusu değişkenlerin ekonomik büyüme üzerindeki etkilerinin birlikte değerlendirilmesi önem arz etmektedir. BRICS ülkeleri son yıllarda küresel ekonomik büyümenin önemli aktörleri arasında yer almakta olup, turizm potansiyelleri, ticaret yapıları, yatırım düzeyleri ve dijital dönüşüm süreçleri bakımından farklı özellikler sergilemektedir. Ayrıca incelenen dönemde BRICS ülkelerinde uluslararası turist sayılarında önemli artışlar meydana gelmiştir. Bu durum, ekonomik büyümenin belirleyicilerinin söz konusu ülkeler özelinde incelenmesini gerekli kılmaktadır. Bu çalışmanın amacı, BRICS ülkelerinde turizm, fiziksel sermaye, ticari açıklık ve internet kullanımının ekonomik büyüme üzerindeki etkilerini 1995–2019 dönemi için ampirik olarak incelemektir. Çalışma, ilgili değişkenleri aynı model içerisinde ele alması ve yatay kesit bağımlılığı ile heterojenliği dikkate alan AMG tahmincisini kullanarak hem panel hem de ülke bazında sonuçlar sunması bakımından literatüre katkı sağlamayı amaçlamaktadır.

2. Literatür

Turizm, fiziksel sermaye, ticari açıklık ve internet kullanımının ekonomik büyüme üzerindeki etkileri uzun yıllardır araştırmacıların ilgi odağı olmuştur. Turizm ve ekonomik büyüme ilişkisini inceleyen çalışmaların önemli bir bölümü, turizmin ekonomik büyümeyi desteklediğini ortaya koymaktadır. Özellikle BRICS ülkeleri ve gelişmekte olan ekonomiler üzerine yapılan araştırmalar, turizm faaliyetlerinin ekonomik performans üzerinde pozitif etkiler yaratabildiğini göstermektedir. Bununla birlikte, bazı çalışmalar turizmin ekonomik büyüme üzerindeki etkisinin ülkelerin gelir düzeyi, dijitalleşme kapasitesi ve kurumsal yapısına bağlı olarak farklılaşabileceğini ortaya koymaktadır. Fiziksel sermaye ile ekonomik büyüme arasındaki ilişkiyi inceleyen çalışmalar ise genel olarak sermaye birikiminin üretim kapasitesini artırarak ekonomik büyümeyi desteklediğini göstermektedir. Özellikle gelişmekte olan ülkelerde gerçekleştirilen ampirik çalışmalar, gayri safi sabit sermaye oluşumunun ekonomik büyüme üzerinde çoğunlukla pozitif ve anlamlı etkiler yarattığını ortaya koymaktadır. Ancak bazı araştırmalar, söz konusu etkinin ülke özelliklerine ve ekonomik gelişmişlik düzeyine bağlı olarak değişebileceğine işaret etmektedir.

Ticari açıklık ve ekonomik büyüme ilişkisine yönelik literatürün büyük bölümü, ticaretin serbestleşmesinin ekonomik büyümeyi olumlu etkilediğini göstermektedir. Ticari açıklığın teknoloji transferini hızlandırması, kaynak tahsisini iyileştirmesi ve verimlilik artışlarını desteklemesi nedeniyle ekonomik performansı geliştirebildiği ifade edilmektedir. Bununla birlikte, ticari açıklığın ekonomik büyüme üzerindeki etkisinin ülkelerin gelir düzeyi ve ekonomik yapısına göre farklılaşabildiği de belirtilmektedir. İnternet kullanımı ve ekonomik büyüme arasındaki ilişkiyi inceleyen çalışmalar ise internet kullanımının bilgiye erişimi kolaylaştırması, işlem maliyetlerini azaltması ve ekonomik etkinliği artırması yoluyla büyümeyi destekleyebileceğini göstermektedir. Ancak internet kullanımının ekonomik büyüme üzerindeki etkisinin ülkelerin teknolojik altyapı düzeylerine ve dijital dönüşüm kapasitelerine bağlı olarak değişebildiği de vurgulanmaktadır.

Genel olarak değerlendirildiğinde, mevcut literatür turizm, fiziksel sermaye, ticari açıklık ve internet kullanımının ekonomik büyüme üzerinde etkili olabileceğine işaret etmektedir. Bununla birlikte, söz konusu değişkenleri birlikte ele alan ve BRICS ülkeleri özelinde yatay kesit bağımlılığı ile heterojenliği dikkate alan güncel çalışmaların sınırlı olduğu görülmektedir. Bu çalışma, ilgili değişkenleri aynı model içerisinde inceleyerek ve AMG tahmincisini kullanarak söz konusu literatür boşluğuna katkı sunmayı amaçlamaktadır.

3. Yöntem ve Ampirik Bulgular

Çalışmada BRICS ülkelerinde ekonomik büyüme ile turizm, fiziksel sermaye, ticari açıklık ve internet kullanımı arasındaki uzun dönemli ilişkiler 1995–2019 dönemine ait yıllık veriler kullanılarak analiz edilmiştir. Analiz sürecinde öncelikle yatay kesit bağımlılığı ve homojenlik testleri uygulanmıştır. Elde edilen bulgular, panelde yatay kesit bağımlılığının bulunduğunu ve eğim katsayılarının heterojen olduğunu göstermiştir. Bu nedenle ikinci nesil birim kök testlerinden CADF testi kullanılmış, değişkenler arasında uzun dönemli ilişkinin varlığı ise Westerlund Durbin-Hausman eşbütünleşme testi ile araştırılmıştır. Eşbütünleşme test sonuçları, değişkenler arasında uzun dönemli bir ilişkinin bulunduğunu ortaya koymuştur. Uzun dönem katsayılarının tahmininde ise yatay kesit bağımlılığını ve heterojenliği dikkate alan Genişletilmiş Ortalama Grup (AMG) tahmincisi kullanılmıştır. Ampirik bulgular, panel genelinde fiziksel sermaye ve internet kullanımı ile ekonomik büyüme arasında pozitif

ve istatistiksel olarak anlamlı uzun dönemli ilişkiler bulunduğunu göstermektedir. Buna göre fiziksel sermayedeki %1’lik artışın ekonomik büyümedeki yaklaşık %0,324’lük artışla, internet kullanımındaki %1’lik artışın ise ekonomik büyümedeki yaklaşık %0,044’lük artışla uzun dönemde ilişkili olduğu belirlenmiştir. Buna karşın turizm ve ticari açıklık ile ekonomik büyüme arasında panel genelinde istatistiksel olarak anlamlı uzun dönemli bir ilişki bulunmamıştır.

Ülke bazında elde edilen sonuçlar ise önemli farklılıklar ortaya koymaktadır. Brezilya’da tüm değişkenler anlamlı bulunurken, ticari açıklık ile ekonomik büyüme arasında negatif; turizm, fiziksel sermaye ve internet kullanımı ile ekonomik büyüme arasında ise pozitif ve istatistiksel olarak anlamlı uzun dönemli ilişkiler tespit edilmiştir. Rusya’da fiziksel sermaye ve internet kullanımı ile ekonomik büyüme arasında pozitif ve istatistiksel olarak anlamlı uzun dönemli ilişkiler bulunurken, turizm ve ticari açıklık ile ekonomik büyüme arasındaki ilişkiler istatistiksel olarak anlamlı bulunmamıştır. Hindistan’da internet kullanımı ile ekonomik büyüme arasında pozitif, ticari açıklık ile ekonomik büyüme arasında ise negatif ve istatistiksel olarak anlamlı uzun dönemli ilişkiler tespit edilirken, turizm ve fiziksel sermaye ile ekonomik büyüme arasındaki ilişkilerin istatistiksel olarak anlamlı olmadığı belirlenmiştir. Çin’de fiziksel sermaye ve internet kullanımı ile ekonomik büyüme arasında pozitif, ticari açıklık ile ekonomik büyüme arasında ise negatif ve istatistiksel olarak anlamlı uzun dönemli ilişkiler bulunurken, turizm ile ekonomik büyüme arasındaki ilişki istatistiksel olarak anlamlı bulunmamıştır. Son olarak, Güney Afrika’da fiziksel sermaye ve internet kullanımı ile ekonomik büyüme arasında pozitif, turizm ile ekonomik büyüme arasında ise negatif ve istatistiksel olarak anlamlı uzun dönemli ilişkiler tespit edilirken, ticari açıklık ile ekonomik büyüme arasındaki ilişki istatistiksel olarak anlamlı bulunmamıştır.

4. Sonuç ve Politika Önerileri

Bu çalışmada BRICS ülkelerinde turizm, fiziksel sermaye, ticari açıklık ve internet kullanımının ekonomik büyüme üzerindeki etkileri 1995–2019 dönemi için incelenmiştir. Yatay kesit bağımlılığı ve heterojenliği dikkate alan AMG tahmincisinden elde edilen bulgular, panel genelinde fiziksel sermaye ve internet kullanımının ekonomik büyümeyi pozitif ve istatistiksel olarak anlamlı biçimde etkilediğini göstermektedir. Buna karşılık turizm ve ticari açıklık değişkenlerinin panel düzeyinde anlamlı bir etkiye sahip olmadığı tespit edilmiştir. Ülke bazında elde edilen sonuçlar ise değişkenlerin ekonomik büyüme üzerindeki etkilerinin ülkelere göre farklılaştığını ortaya koymaktadır. Elde edilen bulgular, BRICS ülkelerinde ekonomik büyümenin özellikle sermaye birikimi ve dijital dönüşüm süreçleri tarafından desteklendiğine işaret etmektedir. Fiziksel sermayenin büyüme üzerindeki pozitif etkisi, yatırım harcamalarının üretim kapasitesinin artırılmasındaki önemini ortaya koyarken, internet kullanımının pozitif etkisi dijitalleşmenin ekonomik performans üzerindeki katkısını göstermektedir. Buna karşın turizm ve ticari açıklık değişkenlerinin etkilerinin ülkeler arasında farklı yönlerde ortaya çıkması, ekonomik büyümenin belirleyicilerinin ülkeye özgü koşullardan etkilendiğini göstermektedir. Bu bulgular doğrultusunda, BRICS ülkelerinde sürdürülebilir ekonomik büyümenin desteklenmesi amacıyla üretken yatırımları teşvik eden politikaların sürdürülmesi ve dijital altyapının geliştirilmesine öncelik verilmesi önerilmektedir. Özellikle bilgi ve iletişim teknolojilerine yönelik yatırımların artırılması, dijital dönüşüm süreçlerinin hızlandırılması ve internet erişiminin yaygınlaştırılması ekonomik performansın güçlendirilmesine katkı sağlayabilir. Bununla birlikte, turizm ve ticari açıklığın ekonomik büyüme üzerindeki etkilerinin ülkeden ülkeye farklılaşması nedeniyle, bu alanlara yönelik politikaların her ülkenin ekonomik yapısı, üretim deseni ve dış ticaret özellikleri dikkate alınarak tasarlanması gerekmektedir.

Sonuç olarak çalışma, BRICS ülkelerinde ekonomik büyümenin belirleyicilerinin homojen bir yapı sergilemediğini ve ülke dinamiklerinin politika tasarımı dikkate alınmasının önem taşıdığını göstermektedir. Gelecek araştırmalarda farklı ülke gruplarının incelenmesi ve kurumsal kalite, finansal gelişme veya beşeri sermaye gibi değişkenlerin modele dâhil edilmesi, ekonomik büyümenin belirleyicilerinin daha kapsamlı biçimde değerlendirilmesine katkı sağlayabilir.