



Entrepreneurship and economic growth: Evidence from the emerging BRICS economies

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ABSTRACT

Entrepreneurship has recently attracted great attention from researchers due to its enormous growth-enhancing effects. However, the empirical literature has not paid sufficient attention to the explicit relationship between entrepreneurship and economic growth. This paper aims to explore the potential relationship between entrepreneurship and economic growth by focusing on the emerging BRICS economies. The study utilizes data from 2002 to 2021 and employs a range of estimation tools including pooled least squares, fixed effects, generalized least squares and two stages least squares. The results find that entrepreneurship has a positive and significant influence on economic growth in the BRICS economies. Similarly, trade openness and physical capital have also contributed to overall economic growth. Moreover, the relationship between human capital and economic growth is both positive and statistically significant for the BRICS economies. Finally, the causality testing revealed a one-way relationship running from entrepreneurship towards economic growth. Given the results obtained in this study, encouraging young people to pursue entrepreneurial careers is likely to contribute towards addressing the problem of youth unemployment in the BRICS economies.

Introduction

The relationship between entrepreneurship and economic growth has recently received significant attention from researchers and policymakers. Entrepreneurs are key drivers of economic growth because of their enormous contribution towards the creation of new jobs and the emergence of new innovations (Stoica et al., 2020). Innovative entrepreneurs are important for the competitiveness of any economy, and accelerate economic growth through innovative technologies, products, and services (KritiKoS, 2014). Research (Surya et al., 2021) underscores that empowering both small and medium enterprises are essential for enhancing economic growth. Entrepreneurs' innovative products are usually more competitive because these products help firms to get access to wider markets Galindo, Méndez (2014). Gaba and Gaba (2022) posit that entrepreneurship helps economies to achieve higher economic growth through provision of higher levels of employment and greater innovation. Studies (e.g., Rauter et al., 2019) suggest that higher collaboration with NGOs is a crucial factor for firm performance. But other researchers (Skare, Porada-Rochon, 2022) pointed out that

innovation is important but not sufficient for long run sustainability. Hence, it is vital to remember that all types of high economic growth activities positively improve the quality of life (Tahir and Azid, 2015; Tahir and Khan, 2014).

Entrepreneurial activities are indeed especially important in the modern globalized world. According to Wang (2022), the purpose of entrepreneurial activities is to solve societal problems and contribute to the process of sustainable development. Kim et al. (2022) point out that innovative entrepreneurs are the main agents of the never-ending Schumpeterian process of creative destruction that is catalyzed by the emergence of new products, services, technologies, firms, and industries. Innovative entrepreneurs pose serious threats to incumbent poorly performing firms and encourage healthy competition, a productive process that enables economies to flourish. Acs (2008) documented that entrepreneurship contributes to thriving businesses, improves productivity, and therefore has a positive impact on economic growth. Empirically, some studies have demonstrated a positive and significant relationship between entrepreneurship and economic growth (Gautam and Lal, 2021; Sabra and Shreteh, 2021; Chen, 2014).

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However, another strand of literature has pointed out that the relationship between entrepreneurship and economic growth is not always straightforward. For instance, a study by Stam and Stel (2009) rejected the presence of a clear relationship between entrepreneurship and economic growth. They concluded that entrepreneurship is irrelevant in affecting the growth performance of low-income economies. They further explained that entrepreneurship only has a positive impact on growth in transitional and high-income economies. Moreover, [Acs \(2008\)](#) pointed out that entrepreneurial activities may be harmful to economic growth in economies that are passing through the early to middle stage of development as many people would be moving from self-employment to waged employment. Conversely, in the case of developing countries, one would expect entrepreneurship to have a more positive impact on economic growth, as people would be moving from waged employment to self-employment. Finally, the study by [Kim et al. \(2022\)](#) found that only opportunity-driven entrepreneurship (rather than entrepreneurship on the aggregate) is positively associated with economic growth in the case of developing economies.

Hence, the main objective of this study is to explore the explicit relationship between entrepreneurship and economic growth in the less researched BRICS economies (i.e., Brazil, The Russian Federation, India, China, and South Africa). The BRICS economies have done remarkably well in terms of economic growth. Together, they account for 25% of the world's land area, 40% of the global population and have a combined GDP of more than US\$ 1 trillion for four economies ([Lowe, 2016](#)). However, recent literature has highlighted the fact that surprisingly, economic performance has recently slowed down. Currently, youth unemployment is the major concern for all BRICS economies. South Africa has the highest youth unemployment followed by Brazil, while the remaining three economies have an average youth unemployment rate of 12.6 per cent (ILO, 2018). These growing unemployment rates might be addressed by more effective policies to encourage entrepreneurship. Increased entrepreneurship will not only address the problem of youth unemployment but will also accelerate the speed of economic growth.

The current study contributes to literature in three ways. Firstly, there is no consensus among researchers on whether entrepreneurship is harmful or beneficial to economic growth. This may be because literature has rarely researched the potential relationship between entrepreneurship and economic growth and when it has the findings are contradictory ([Gomes et al., 2022](#)). Similarly, [Kim et al. \(2022\)](#) argued that the role of entrepreneurship is still under-researched in literature. Secondly, it is also not clear whether entrepreneurship produces economic growth or economic growth encourages entrepreneurship, or whether there is a bidirectional relationship ([Almodóvar-González et al., 2020](#)). Therefore, the current study employs the [Dumitrescu, Hurlin \(2012\)](#) approach to identify the direction of the relationship between entrepreneurship and economic growth. Thirdly, this paper adds to the literature contextually by focusing on the BRICS economies where the relationship between entrepreneurship and economic growth is under-researched despite their huge populations and growing unemployment rates. We expect that the study will be helpful for both policymakers in the BRICS economies and researchers.

The rest of the paper is as follows. Section two focuses on a discussion of empirical literature. Important statistics on entrepreneurship, economic growth, and other macroeconomic variables in the BRICS economies are in section three. The methodology and models applied for estimation purposes are in section four. Section five provides the empirical results and discussion. The penultimate section presents the causality results, followed by conclusion, implications, and limitations of this research.

Literature review

The importance of entrepreneurship in enhancing economic growth has recently received attention from both policymakers and

researchers. This is because of the enormous benefits associated with entrepreneurship for the host economies. However, empirical research on the relationship between entrepreneurship and economic growth has produced contradictory findings ([Gomes et al., 2022](#)). Some studies have shown that entrepreneurship has a positive economic effect while others have concluded that it is ineffective in enhancing economic growth. Moreover, recent research has found that the impact of entrepreneurship on economic growth is heavily dependent on the economic stage of a particular country ([Almodóvar-González et al., 2020](#)). In addition, the study by [Kim et al. \(2022\)](#) shows that only opportunity-driven entrepreneurship is positively associated with economic growth in the case of developing economies.

One strand of the literature argues that entrepreneurship is a necessary pre-requisite for achieving higher economic growth. Recent research focusing on the G-20 economies has demonstrated a positive and meaningful relationship between entrepreneurship and economic growth ([Gautam and Lal, 2021](#)). Similarly, when considering the economy of Taiwan, [Chen \(2014\)](#) reported a positive and significant relationship between entrepreneurship and economic growth. [Smith \(2010\)](#) also found a positive relationship between entrepreneurship and economic growth. Focusing on 26 European economies, [Dabkowski \(2011\)](#) provided evidence that supported the moderate positive influence of entrepreneurship on economic growth. Moreover, [Savrul \(2017\)](#) demonstrated a long run positive relationship between entrepreneurship and economic growth for 35 countries by using data from 2006 to 15. The key finding in all these research studies underscores that entrepreneurship is one of the driving forces behind economic growth. Opportunity-led entrepreneurship is particularly effective in accelerating economic growth ([Aparicio et al., 2016](#)).

However, some research studies argue that entrepreneurship may be detrimental to economic growth. For instance, [Doran et al. \(2018\)](#) found empirically that entrepreneurship only has a positive impact on economic growth in developed economies, while being a hindrance in developing economies. [Sternberg and Wennekers \(2005\)](#) found that the role of entrepreneurial activity differs depending on the stage of economic development of a particular country and is only positive for developed economies while having a negative effect on developing economies. In addition, the role that entrepreneurship role in economic development could also be dependent on other specific characteristics of the host economies.

Innovations are a vital part of the firm strategy for achieving significant competitiveness. [Chaston and Scott \(2012\)](#) investigated a firm performance in relation to both entrepreneurship and open innovation. They found that firms having higher open innovation tendencies achieve significant improvements in sales growth. Recent research ([Mikhaylov et al., 2023](#)) documents that financial development and open innovation are correlated with each other in the context of developed as well as developing economies. [Rauter et al. \(2019\)](#) investigated firms open innovations in relation to economic and sustainability innovation performance and found that a higher collaboration with non-governmental organization (NGOs) is important for firm performance. When firms collaborate with different financial intermediaries, it is bound to enhance the overall performance of the firms and consequently, improve economic growth ([Béraud et al. \(2012\)](#)). Further, the combine impact of creation processes and entrepreneurial visions leads to comparative advantage for industries. However, [Skare, Porada-Rochon \(2022\)](#) suggest that innovation becomes trivial in the long run.

[Gomes et al. \(2022\)](#) highlighted the literature on the relationship between entrepreneurship and economic growth is conflicted and contradictory. [Kim et al. \(2022\)](#) pointed out that due to lack of data, the role played by entrepreneurship in economic growth is under-researched. Further, it is not clear whether entrepreneurship contributes to economic growth, the latter encourages entrepreneurship, or whether there is a bidirectional relationship between the two ([Almodóvar-González et al., 2020](#)). In the context of the BRICS economies, the

relationship between entrepreneurship and economic growth is less investigated. Therefore, this study tries to assess this research gap in the entrepreneurship literature by focusing on the nature and direction of the relationship between entrepreneurship and economic growth in the BRICS economies.

Research questions

Based on our literature review, we formulate the following research questions.

- 1) What is the relationship between entrepreneurship and economic growth?
- 2) What is the direction of the relationship between entrepreneurship and economic growth?
- 3) How does trade openness, human capital, and investment affect entrepreneurship?

Development of hypothesis

We empirically assess the following hypotheses.

- 1) “Entrepreneurship is positively related with economic growth”.
- 2) “Trade openness is positively related with economic growth”.
- 3) “Investment is positively related to economic growth”.
- 4) “Education is positively related to economic growth”.

Important statistics

This section provides key statistics on entrepreneurship, GDP per capita, trade openness, investment, and education for the BRICS members. Global Entrepreneurship Monitor (GEM) is the source of our entrepreneurship data, and the data source of all other variables is from the World Development Indicators. According to the statistics reported in Table 1, entrepreneurial activity “Percentage of 18–64 population who are either a nascent entrepreneur or owner-manager of a new business” has increased by approximately 40 per cent between 2002 and 2021. GDP per capita for the BRICS member countries has also grown over the last two decades from US\$ 4257.057 in 2002 to US\$ 7557.100 in 2021—a remarkable net increase of more than 77 per cent. The observed significant increases in both entrepreneurship and GDP per capita could be an indication of a relationship between the two phenomena.

Surprisingly, trade openness has only increased marginally. Trade as a percentage of GDP was 42.597 in 2002 but had only risen to 45.697 per cent in 2021, a small increase of 7.277 per cent. However, the ratio of trade to GDP is reasonable. Investment increased by a similar amount of 8.807 per cent between 2002 and 2021. The current level of investment is 24.645 per cent of GDP, a relatively high level when compared to developing countries. Finally, education spending has increased by almost 22% across the BRICS economies during the same period. This implies that the BRICS economies have realized the importance of investing in human capital to support growth.

The overall statistics above are less informative about the trends and

Table 1
Key statistics on selected variables.

Variables	2002	2021	Change (%)
<i>ETR_{i,t}</i>	10.090	14.144	40.178
<i>PGDP_{i,t}</i>	4257.057	7557.100	77.519
<i>TRD_{i,t}</i>	42.597	45.697	7.277
<i>DINV_{i,t}</i>	22.650	24.645	8.807
<i>EDU_{i,t}</i>	2.328	2.838	21.907

Note: The authors used data from The Global Entrepreneurship Monitor and The World Development Indicators.

Table 2
Country-specific statistics.

Countries	Variables	2002	2021	Change (%)
Brazil	<i>ETR_{i,t}</i>	13.530	20.980	55.062
	<i>PGDP_{i,t}</i>	6904.625	8551.205	23.847
	<i>TRD_{i,t}</i>	27.618	39.176	41.849
	<i>DINV_{i,t}</i>	17.926	19.169	6.934
	<i>EDU_{i,t}</i>	2.127	3.055	43.629
Russia	<i>ETR_{i,t}</i>	2.470	8.320	236.842
	<i>PGDP_{i,t}</i>	5910.167	10219.750	72.918
	<i>TRD_{i,t}</i>	59.645	52.132	-12.596
	<i>DINV_{i,t}</i>	17.905	19.962	11.488
	<i>EDU_{i,t}</i>	2.345	2.682	14.371
India	<i>ETR_{i,t}</i>	16.040	14.370	-10.411
	<i>PGDP_{i,t}</i>	796.724	1961.421	146.185
	<i>TRD_{i,t}</i>	29.508	43.677	48.017
	<i>DINV_{i,t}</i>	28.332	28.327	-0.017
	<i>EDU_{i,t}</i>	1.811	2.155	18.995
China	<i>ETR_{i,t}</i>	12.110	9.563	-21.032
	<i>PGDP_{i,t}</i>	2557.887	11188.300	337.404
	<i>TRD_{i,t}</i>	42.747	37.431	-12.436
	<i>DINV_{i,t}</i>	35.058	42.717	21.846
	<i>EDU_{i,t}</i>	3.191	3.423	7.270
South Africa	<i>ETR_{i,t}</i>	6.300	17.490	177.619
	<i>PGDP_{i,t}</i>	5115.881	5864.821	14.639
	<i>TRD_{i,t}</i>	53.465	56.071	4.874
	<i>DINV_{i,t}</i>	14.027	13.049	-6.972
	<i>EDU_{i,t}</i>	2.163	2.874	32.871

Note: Authors calculation using data from The Global Entrepreneurship Monitor and The World Development Indicators.

variables at the country level. For this purpose, we have also provided key statistics for individual economies in Table 2. The Russian and South African economies have performed better in terms of boosting the levels of entrepreneurship in their economies. According to the given statistics, entrepreneurial activity has grown exponentially in Russia from 2.470 in 2002–8.320 in 2021, an increase of 235.842. During the period 2002–2021, South Africa and Brazil showed a less spectacular but still impressive growth of 177.619 and 55.062. Surprisingly, entrepreneurial activity declined in China and India in the same period (2002–2021). Brazil has the highest level of entrepreneurship according to statistics from 2021, followed by South Africa and India. Russia still has the lowest level of entrepreneurship among the BRICS economies despite tremendous increases over the last twenty years.

GDP per capita has increased for all five members of the BRICS, indicating their improving overall economic performance. China and India achieved significant increases of 337.404 and 146.185 per cent respectively in income levels. Russia also witnessed a significant rise of 72.918 per cent in GDP per capita, with smaller gains for Brazil and South Africa. Current statistics show that China has the highest GDP per capita among the BRICS countries, followed by Russia and Brazil. The Indian economy has the lowest GDP per capita of the BRICS, primarily owing to its huge population.

Trade openness has increased by 48.017 and 41.849 per cent respectively for India and Brazil. Similarly, trade openness has slightly increased in South Africa. In contrast, the trade openness index has surprisingly declined both for the Russian and Chinese economies. The statistics for 2021 shows that the South African economy has the highest level of trade openness followed by Russia. Moreover, China has the lowest trade openness due to the enormous size of its GDP.

The performance of domestic investment has remained sluggish over the years in the BRICS economies. Domestic investment has increased for China, Russia, and Brazil, but has declined in South Africa and India. China has the highest domestic investment ratio followed by India. South Africa has the lowest domestic investment ratio among the BRICS members.

Expenditure on education has increased for all members of the

Table 3
Economic Growth Ranking and Comparison.

Country	Variable	2002	Ranking	2021	Ranking	% Change
Brazil	Economic Growth	1.760	5	4.067	4	131.097
Russia	Economic Growth	5.182	2	5.177	3	-0.106
India	Economic Growth	1.975	4	7.818	2	295.678
China	Economic Growth	8.404	1	8.013	1	-4.658
South Africa	Economic Growth	2.760	3	3.870	5	40.184

BRICS economies. The performance of Brazil is exceptional and is closely followed by South Africa. India and Russia have also performed well. The Chinese economy has marginally improved its overall performance on education in the period considered. The current statistics show that China leads the BRICS, followed by Brazil and South Africa. India currently has the lowest level of education among the BRICS members.

Our results shown a comparison of economic growth rate for BRICS economies. In 2002, the Chinese economic growth was highest among the BRICS economies even though its growth rate has slightly declined by - 4.658% in the period 2002–2021. Brazil had the lowest growth rate of 1.76%, which increased to 4.067 in 2021, a net increase of more than 131%. The Indian economy economic growth remarkably improved from 1.975% in 2002 to 7.818% in 2021. The current growth of Indian economy is the second highest among the BRICS economies. The South African economy has also seen significant improvement in economic growth in the period 2002–2021. Finally, the economic growth of the Russian economy has not improved during the period 2002–2021 although its current economic growth is the third highest among the BRICS economies. [Table 3](#).

Data Source: The World Development Indicators and the economic growth is measured by taking the growth rate of per capita GDP.

Modeling and data

Data sources

The entrepreneurship data source is the Global Entrepreneurship Monitor, and the education data is from the Penn World Tables (PWT) index. The World Bank’s World Development Indicators (WDI) provided the data for trade and investment. [Table 1A](#) in the appendix includes complete information on the construction of the variables and data sources while [Table 2A](#) includes the names of the countries included in the sample.

Measurement of variables

Economic growth is measured by taking the growth in GDP per capita, which is consistent with prior literature ([Tahir and Azid, 2015](#); [Tahir et al., 2019](#), [Tahir and Hayat, 2022](#)). To measure entrepreneurship, this study uses the total early-stage entrepreneurial activity rate following the seminal work of [Kim et al. \(2022\)](#). Total trade as a per cent of GDP is utilized as a proxy for openness to trade. The Penn World Tables (PWT) index of education is used to capture education.

Model specification

The prime objective of this study is, as already mentioned, to explore the relationship between entrepreneurship and economic growth in the BRICS economies. However, there are a number of other factors besides entrepreneurship that could be considered to play a part in economic growth. Prior theoretical and empirical literature has provided support for the growth-enhancing role of investment, trade openness and education. In the first instance, the study specifies the function form for model derivation.

$$PGDPG = F(ETR^a, EDU^b, DINV^c, TRD^d) \tag{1}$$

The functional form expressed by expression 1 shows that economic growth could be explained by entrepreneurship, education, investment, and trade openness. Acknowledging the presence of non-linearities between the independent variables and dependent variable, we use the logarithmic transformation in accordance with previous literature to convert expression 1 into expression 2.

$$PGDPG_{i,t} = \beta_0 + \beta_1 LNETR_{i,t} + \beta_2 LNEDU_{i,t} + \beta_3 LNDINV_{i,t} + \beta_4 LNTRD_{i,t} + U_{i,t} \tag{2}$$

Methodology for estimation

To achieve the objective of this study, panel data with two distinct dimensions (such as time and a cross-sectional dimension) was collected for the period 2002–2021. The dimensions of the data pose several challenges during the estimation process. Over the years, researchers have developed several estimation tools for handling panel data. Among them, the fixed effects (FE) and random effects (RE) tools have gained popularity and are widely used in applied research studies. FE modeling is used in a considerable number of studies as it can effectively control variations in both time and cross-sectional dimensions ([Kim et al., 2022](#), [Tahir et al., 2019](#); [Tahir and Azid, 2015](#), [Tahir, 2020](#)). RE modeling is also used by researchers in applied research studies specifically because it allows for the exploration of the influence of time-invariant characteristics.

The Hausman test (1978) was conducted and confirmed the suitability of FE modeling over RE modeling. Therefore, we have estimated the main model using the FE procedure. In addition, we have also utilized the generalized least square (GLS) method to test the robustness of the results of FE modeling and the two stages least squares (TSLS) method for curing the potential endogeneity problem. Finally, the pooled least square estimator (POLS) is also used as it is considered a first step in panel data modeling.

The correlation of the results as presented in [Table A3](#) in the appendix section provides evidence about the moderate relationship among the variables. The highest correlation of 0.526 is witnessed between economic growth and investment. The lowest correlation of 0.015 is found between trade openness and human capital. All other variables are correlated moderately which is a common phenomenon in applied research. Moreover, the multicollinearity test (VIF) was also conducted, and it rejected the presence of multicollinearity in the estimated model. The results of the VIF test are shown in [Table A4](#) in the appendix section.

Results and discussion

Descriptive statistics

The descriptive statistics shown in [Table 4](#). indicate that the average per capita income is 6159.630 in real terms, a figure that is quite satisfactory when compared to developing economies. The minimum value of 796.724 is recorded for the Indian economy in 2002, while the highest value of 11188.300 is recorded for the Chinese economy in

Table 4
Descriptive Statistics.

	$PGDP_{i,t}$	$ETR_{i,t}$	$EDU_{i,t}$	$DINV_{i,t}$	$TRD_{i,t}$
Mean	6159.763	10.738	2.600	25.555	44.709
Maximum	11188.300	24.010	3.434	44.518	65.974
Minimum	796.724	2.470	1.811	13.049	22.105
Std. Dev.	2964.858	5.053	0.467	9.671	11.394
Observations	100	100	100	100	100

Data Source: The Global Entrepreneurship Monitor and World Development Indicators.

Table 5
Findings (Regression).

Variables	POLS Coefficients	F. E Coefficients
$LNETR_{i,t}$	0.011(0.008)	0.035 *** (0.012)
$LNEDU_{i,t}$	-0.059 *** (0.021)	0.174 *** (0.060)
$LNDINV_{i,t}$	0.019 *** (0.002)	0.070 *** (0.013)
$LNTRD_{i,t}$	0.058 *** (0.013)	0.030 * (0.015)
Constant	-0.674(0.087)	-2.205(0.412)
Diagnostics	R ² : 0.430R ² (Adjusted): 0.405Hausman Test: 36.680 ***F: Test: 17.014 ***	R ² : 0.854R ² (Adjusted): 0.798 F: Test: 15.342 ***

Empirical Results: We applied E-views 10 for the empirical results are extracted. The asterisk (***) and (*) stands for 1% and 10% significance level and the values in parentheses are the standard errors.

Table 6
Sensitivity Analysis.

Variables	GLS Coefficient	TSLS Coefficients
$LNETR_{i,t}$	0.016 ** (0.007)	0.024 ** (0.010)
$LNEDU_{i,t}$	-0.066 *** (0.022)	0.072 *** (0.019)
$LNDINV_{i,t}$	0.020 *** (0.002)	0.019 *** (0.001)
$LNTRD_{i,t}$	0.068 *** (0.011)	0.076 *** (0.014)
Constant	-0.733(0.074)	-0.750(0.092)
Diagnostics	R ² : 0.556R ² (Adjusted): 0.536 F: Test: 28.211 ***	R ² : 0.411R ² (Adjusted): 0.385 F: Test: 19.423 ***

Results are extracted by using E-views 10. The asterisks (***) and (**) stand for 1% and 5% significance level and the standard errors values are in parentheses.

2021. The average value of entrepreneurship is 10.738 while the maximum and minimum values are 24.010 and 2.470 as observed for the Chinese and Russian economies respectively. The mean value of human capital is 2.600 and it has the lowest standard deviation of 0.467. Investment is on average 25.555, while the highest value of 44.518 is recorded for the Chinese economy in 2013 and the lowest value of 13.049 is observed for the economy of South Africa in 2021. Trade openness has a mean value of 44.709 having a standard deviation of 11.394. The lowest value for trade openness is 22.105 for Brazil in 2009 while the highest value is observed for South Africa in 2008. Overall, the levels of trade openness are reasonable, and illustrate the satisfactory implementation of trade liberalization policies by the BRICS members.

Regression findings

The regression results for the POLS and FE modeling are shown in Table 5. The POLS results show that entrepreneurship is insignificantly but positively related to economic growth. Investment and trade openness have a significant and positive influence on economic growth. On the other hand, human capital has a surprisingly significant and negative impact on economic growth. However, we do not place much emphasis on the POLS results as the Hausman test confirmed the

Table 7
Causality results (DH).

Null Hypothesis:	Zbar-Stat.	Prob.
From $LNETR_{i,t}$ to $PGDPG_{i,t}$	2.214 **	0.0268
From $PGDPG_{i,t}$ to $LNETR_{i,t}$	1.096	0.2728
From $LNEDU_{i,t}$ to $PGDPG_{i,t}$	8.654 ***	0.0000
From $PGDPG_{i,t}$ to $LNEDU_{i,t}$	-0.283	0.7770
From $LNDINV_{i,t}$ to $PGDPG_{i,t}$	4.591 ***	4. E-06
From $PGDPG_{i,t}$ to $LNDINV_{i,t}$	0.834	0.4040
From $LNTRD_{i,t}$ to $PGDPG_{i,t}$	1.767 *	0.0771
From $PGDPG_{i,t}$ to $LNTRD_{i,t}$	-0.888	0.3743
From $LNEDU_{i,t}$ to $LNETR_{i,t}$	3.788 ***	0.0002
From $LNETR_{i,t}$ to $LNEDU_{i,t}$	0.808	0.4186
From $LNDINV_{i,t}$ to $LNETR_{i,t}$	3.096 ***	0.0020
From $LNETR_{i,t}$ to $LNDINV_{i,t}$	0.132	0.8946
From $LNTRD_{i,t}$ to $LNETR_{i,t}$	0.968	0.3326
From $LNETR_{i,t}$ to $LNTRD_{i,t}$	1.480	0.1387
From $LNDINV_{i,t}$ to $LNEDU_{i,t}$	-0.236	0.8131
From $LNEDU_{i,t}$ to $LNDINV_{i,t}$	1.098	0.2721
From $LNTRD_{i,t}$ to $LNEDU_{i,t}$	3.244 ***	0.0012
From $LNEDU_{i,t}$ to $LNTRD_{i,t}$	3.281 ***	0.0010
From $LNTRD_{i,t}$ to $LNDINV_{i,t}$	0.584	0.5588
From $LNDINV_{i,t}$ to $LNTRD_{i,t}$	1.150	0.2501

Note: Results are extracted using E-views 10. The asterisk (***), (**) and (*) stand for 1,5% and 10% significance level.

suitability of using the FE tool for estimation purposes. However, the POLS does help in providing some clues about the potential relationship between the dependent and independent variables (Chen and Gupta, 2009; Tahir and Azid, 2015).

Table 5 shows the FE results. Entrepreneurship has positively and significantly influenced the economic growth of the BRICS economies, a finding that is consistent with the research of Kim et al. (2022). Entrepreneurship influences economic growth through multiple channels including employment generation, higher levels of innovation, and increased production. Gautam and Lal (2021) found that entrepreneurship has positively impacted the economic growth of the G-20 economies. They suggested that policymakers should encourage innovative entrepreneurial activities to enhance economic growth. The BRICS member economies should follow the path of the G-20 economies by promoting entrepreneurial activities to accelerate economic growth and address their problems of high youth unemployment.

Our findings also suggest that the development of human capital has a positive and major influence on the economic growth of the BRICS economies. Prior research (Barro, 2001; Fernandez and Mauro, 2000, Tahir et al., 2020) also support our results. Fernandez and Mauro (2000) found that education has multidimensional benefits, which gradually translate into economic growth. The descriptive statistics above show that education has increased gradually in the BRICS economies over recent years, and this could therefore be a probable reason for the observed positive influence of education on economic growth.

Investment has also impacted economic growth positively and significantly, which is consistent with prior expectations and previous literature. Investment generates employment opportunities and increases in production through which economies receive additional

income (Ribaj, Mexhuani, 2021). The BRICS economies need to invest heavily in their economies to achieve higher economic growth.

Finally, the study found that openness to international trade has helped the BRICS economies to boost growth. The coefficient of trade openness in the estimated model is positive and statistically different from zero. There is convincing evidence of a positive relationship between trade and growth in the literature (Dollar, 1992; Frankel and Romer, 1999; Tahir and Azid, 2015). Openness to trade helps economies to access advanced technologies that make an enormous contribution to the growth process.

Sensitivity analysis

The results of the sensitivity exercise using the GLS and TSLS methods are illustrated in Table 6. The GLS results show that entrepreneurship is positively and significantly linked with economic growth, consistent with the results using FE. The TSLS based results also confirmed a positive and statistically significant relationship between entrepreneurship and economic growth. The positive relationship between investment, trade openness and economic growth remains robust in both the GLS and TSLS estimations. However, the positive influence of education on growth became significantly negative in the GLS estimation.

Causality results

The pairwise results of causality testing based on Dumitrescu and Hurlin are shown in Table 7. Our results show one-way as well as two-ways casual relationships among the applied variables. A one-way causal relationship running from entrepreneurship towards economic growth is observed. It implies that entrepreneurship is causing economic growth unilaterally. Further, our show that both education and investment are causing economic growth unilaterally in the context of BRICS economies. Education and investment are unilaterally initiating entrepreneurship. Our results also show a one-way relationship running from trade openness towards economic growth. We also found a bi-directional relationship between trade openness and education.

Concluding remarks

This research paper has aimed to deviate from the traditional way of accounting for growth by highlighting the key role of entrepreneurship. The paper focused on all five members of the BRICS economies and sourced data for the period 2002–2021. The study employed suitable tools for the estimation of panel data to extract results.

The results are robust to alternative estimation methods and provide evidence of the positive and major influence that entrepreneurship has

Appendix A

Table A1, Table A2, Table A3, Table A4.

Table A1
Variables Description.

Variables	Description	Source
Entrepreneurship ($LNTR_{i,t}$)	Percentage of 18–64 population who are either a nascent entrepreneur or owner-manager of a new business	GEM Database
Economic Growth ($PGDPG_{i,t}$)	GDP per Capita (Growth)	WDI
Trade ($LNTRD_{i,t}$)	Trade % of GDP	WDI
Investment ($LNDINV_{i,t}$)	Gross fixed capital formation	WDI
Education ($LNEDU_{i,t}$)	Human capital index, based on years of schooling and returns to education; see Human capital in PWT9.	Penn World Tables

on economic growth, a finding that is consistent with the scarce prior literature on this facet of the BRICS economies and hypothesized perceptions. This implies that the BRICS economies can address their problem of high youth unemployment by supporting and encouraging more entrepreneurial activities. Besides entrepreneurship, the study also found that trade openness also has a positive impact on economic growth. Similarly, both education and domestic investment boost economic growth enormously. The causality results show that there is a unilateral relationship between entrepreneurship and economic growth. This implies that high economic growth is possible by encouraging entrepreneurial activities.

Implications of the findings

This study suggests that there are significant policy implications based on the robust empirical findings.

- 1) The most important implication of the study is that greater efforts should undertake to encourage entrepreneurship in the BRICS economies. It is an integral determinant of economic growth. However, a supportive and business-friendly environment should be in place to reap the full benefits of entrepreneurial activities.
- 2) Our study found significant evidence of the positive impact of domestic investment and education on economic growth. Therefore, all members of the BRICS must constantly invest in education, and channel funds to support productive investments. These policy steps are likely to boost economic growth.
- 3) This study shows that trade openness has a clear growth-enhancing impact on the economies of the BRICS. Therefore, policymakers should support further liberalization of trade among the BRICS member states.

Limitations of this research

- 1) Due to small cross-section of panel data, this study could not apply advanced methodologies such as the generalized method of moments (GMM). This is the main limitation of our study.
- 2) The second limitation is that it focuses on only four determinants of economic growth to avoid the degrees of freedom problem. Economic growth is a multidimensional phenomenon and encompasses other factors, which should have been included in the research model.
- 3) Finally, the transferability and generalization of the results in this paper is limited as the BRICS are quite different from other global economies in terms of macroeconomic indicators such as economic size and structure.

Table A2
List of Countries.

Brazil	Russia	India
China	South Africa	

Table A3
Correlation Results.

	$PGDPG_{i,t}$	$LNETR_{i,t}$	$LNEDU_{i,t}$	$LNDINV_{i,t}$	$LNTRD_{i,t}$
$PGDPG_{i,t}$	1	0.076	0.076	0.526	0.247
$LNETR_{i,t}$	0.076	1	0.345	0.331	-0.467
$LNEDU_{i,t}$	0.076	0.345	1	0.430	0.015
$LNDINV_{i,t}$	0.526	0.331	0.430	1	-0.134
$LNTRD_{i,t}$	0.247	-0.467	0.015	-0.134	1

Data Source: The Global Entrepreneurship Monitor and The World Development Indicators.

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Table A4
Multicollinearity Testing.

Variable	Coefficient	Centered
$LNETR_{i,t}$	6.10E-05	VIF 1.479330
$LNEDU_{i,t}$	0.000488	1.844755
$LNDINV_{i,t}$	5.73E-06	1.667362
$LNTRD_{i,t}$	0.000133	1.235105
C	0.005612	NA

Note: Results are extracted by using E-views 10. No multicollinearity is detected by applying the VIF test.

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