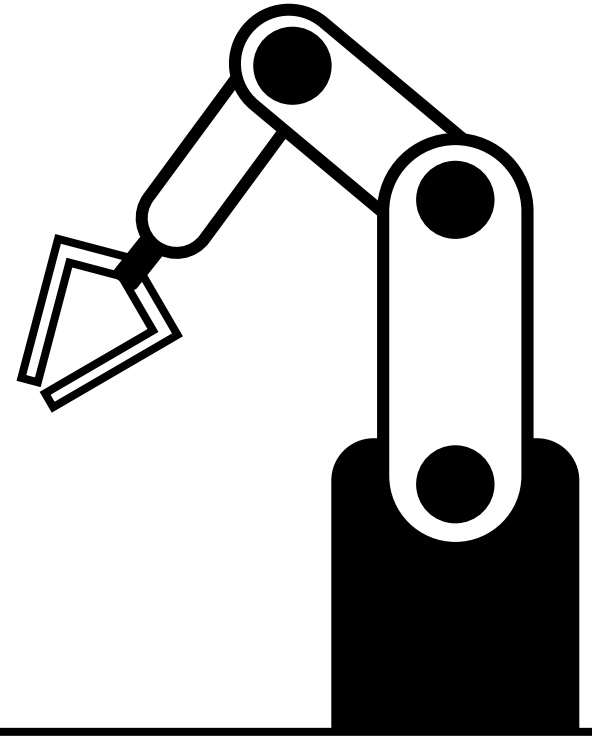
BRICS countries technological development trajectories in the pursuit of technological sovereignty



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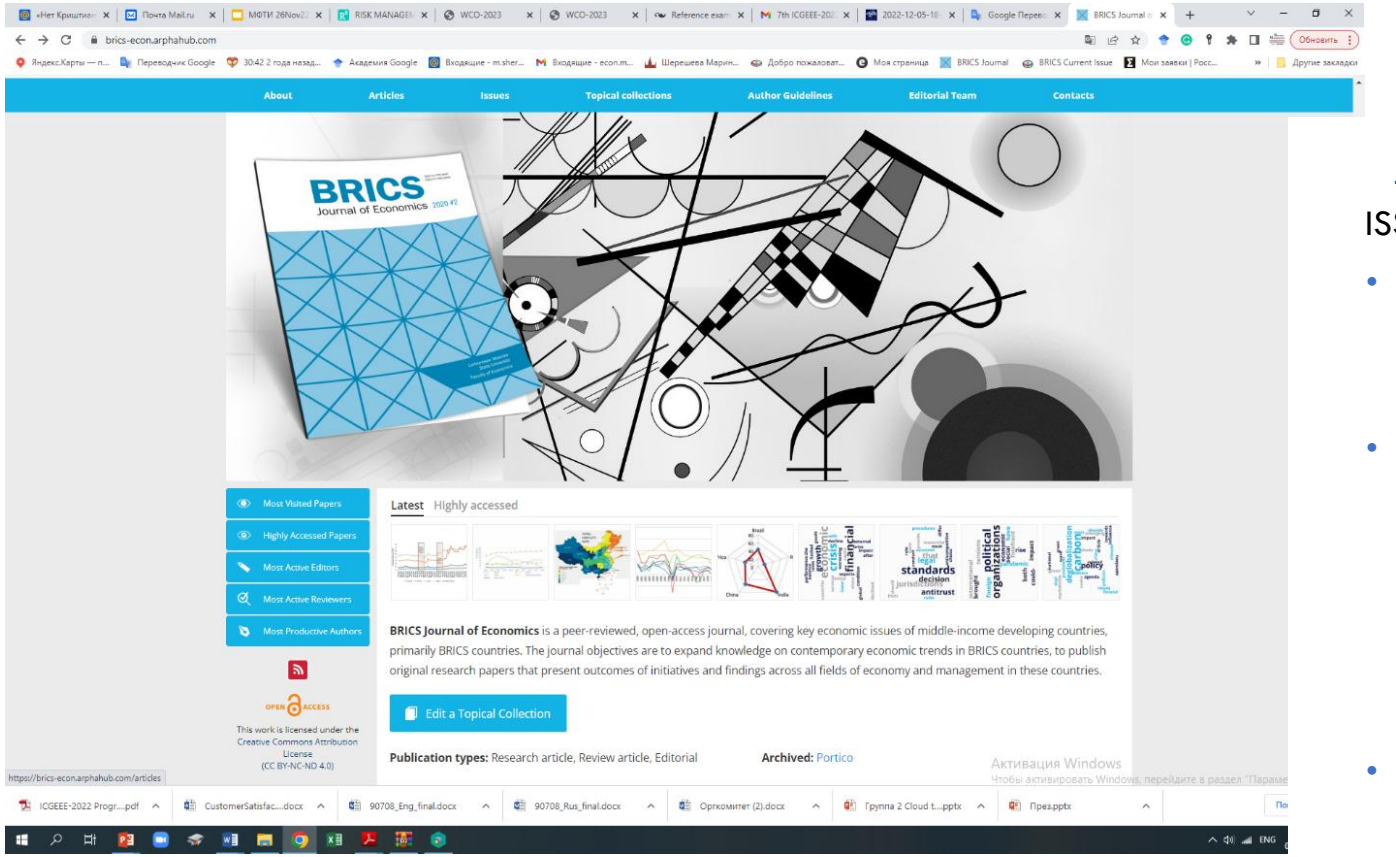

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- A **peer-reviewed, open-access** journal, covering key economic issues of middle-income developing countries, primarily BRICS+ countries
- The journal objectives are to expand knowledge on contemporary economic trends in BRICS countries, to publish original research papers that present outcomes of initiatives and findings across all fields of economy and management in these countries
- Publication types: research article, review article, editorial
- **Four issues per year**
- Publication in the journal is **free of charge** thanks to the support of the Public Joint Stock Company VTB Bank and the Faculty of Economics, Lomonosov Moscow State University

INTRODUCTION

Research Relevance

- There is a geopolitical turbulence actualizing the task of enhancing technological potential
- There is a need to increase technological potential in certain BRICS countries, to shape science and technology policy directions, and to diversify strategic partnerships among BRICS countries
- There are practically no studies analyzing the national technological frontiers of the BRICS countries

Purpose

The BRICS countries' national technological frontiers analysis relative to the global technological frontier

The Main Contribution

- Confirmed the accelerated growth in science and technology potential of the BRICS countries, but unveiled that their development trajectories remain structurally heterogeneous
- The BRICS countries were clustered according to three integral characteristics of the technological boundary trajectory

LITERATURE REVIEW

- **Technological frontier (TF)** is **the level of aggregated productivity that enables a country to achieve the highest per capita GDP, and, consequently, welfare growth** (Katukov et al., 2019; Lau et al., 2023)
- The TF concept arose within the framework of the **theory of endogenous economic growth** and is connected with aggregate factor productivity (Caselli & Coleman, 2006; Acs & Sanders, 2021; Balatsky, 2021)
- **Total factor productivity (TFP)** indicates an **assessment of the level of technological progress** and represents the difference in weighted growth rates between output and other factors of production (Islam et al., 2006; Zhen et al., 2021)
- In a number of studies, **TFP** is understood as the **technological capabilities of the economy**, as a set of the most efficient production methods available with the level of capital and labor (Filippetti & Peyrache, 2017; Lafuente et al., 2020). National TF reflects the highest productivity in a country and contributes to the consolidation of its technological sovereignty
- Concerning the BRICS countries, a number of studies have addressed the issue of ensuring technological sovereignty (Crespi et al., 2021; Edler et al., 2023; Jimenez-Moro et al., 2023; March & Schieferdecker, 2023), yet there are practically no studies analyzing the national technological frontiers of the BRICS countries

METHODOLOGY

Two approaches: the development of separate statistical indicators and the use of the production function apparatus

- Index Approach
- Production Function Approach

$$lnY_{it} = lnA_{it} + \alpha lnK_{it} + \beta L_{it} + \varepsilon_{it}$$

where Y_{it} is the GDP of each of the BRICS countries, K_{it} is the fixed capital of each of the BRICS countries, L_{it} is the labor force of the BRICS countries, A_{it} is the technological frontier, ε_{it} is a random error

The database of the World Bank (World Development Indicators, 2025) was used as an information base

GDP data used as the main output. The gross fixed capital indicator used as a capital factor. The number of workers as labor factor

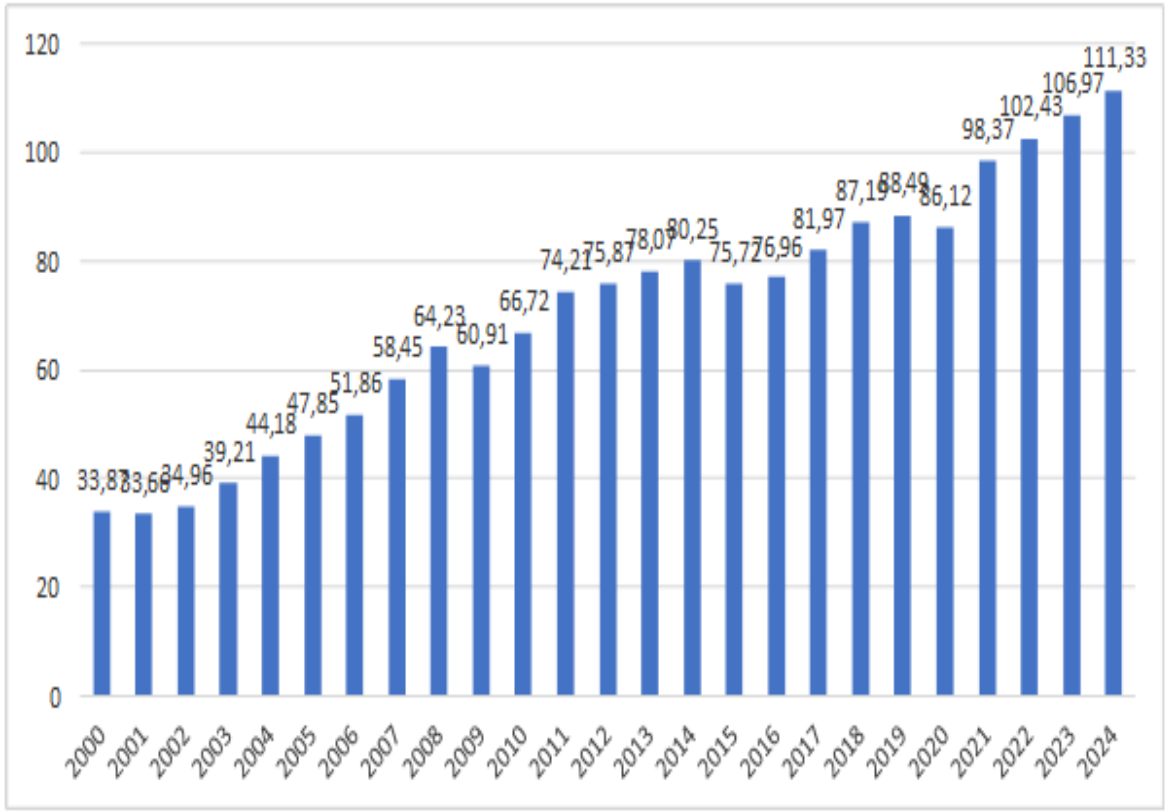
The averaged ranges of values used as parameters α and β:

α = 03 – 0.33; β = 0.66 – 0.7

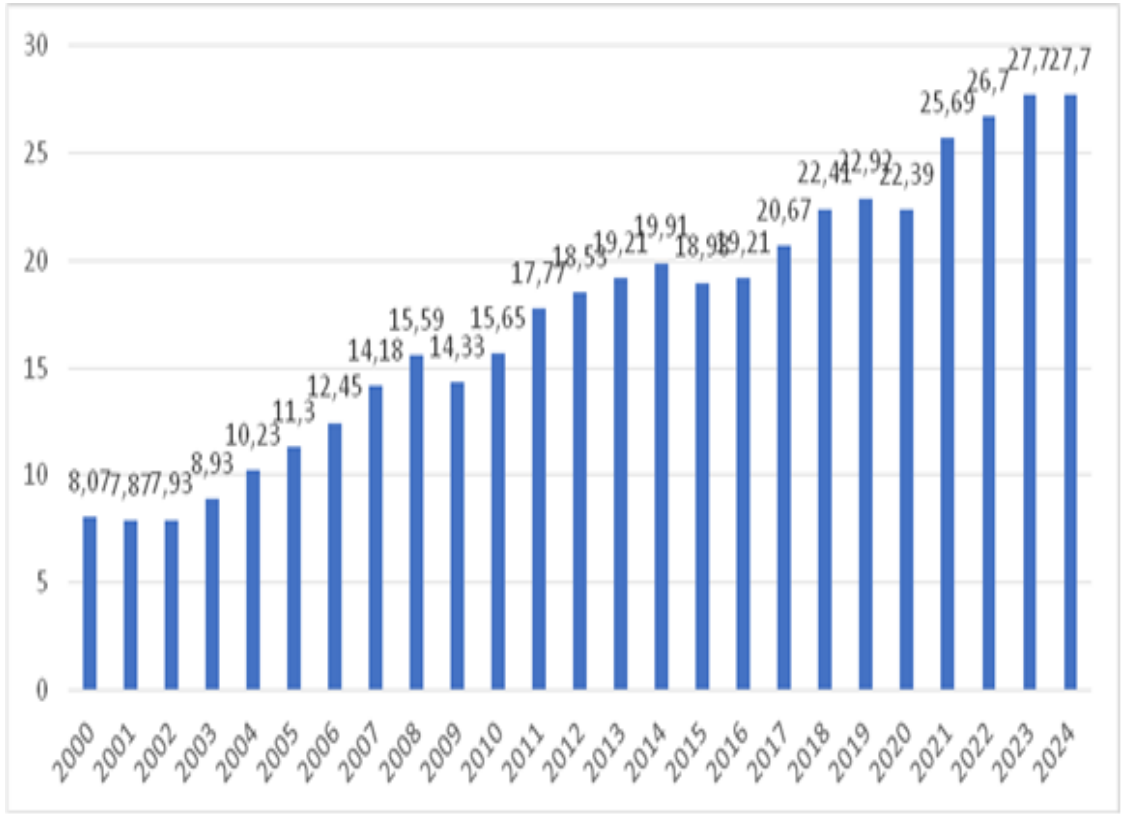
(α is interpreted as a capital contribution, β as a labor contribution)

The present study uses **a linearized version of the Cobb-Douglas function,** taking into account the time trend and the remainder reflecting the cumulative factorial performance

RESULTS: DYNAMICS OF GLOBAL GDP AND GLOBAL TECHNOLOGICAL FRONTIER

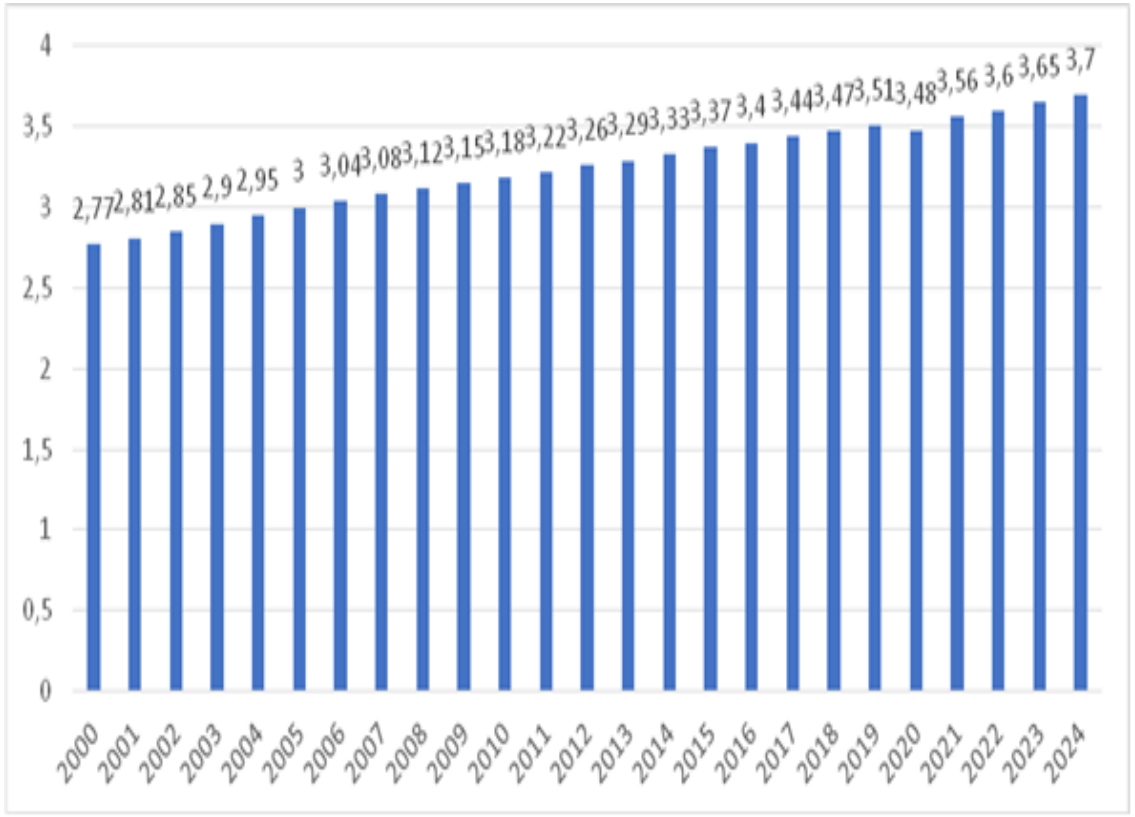


Dynamics of global GDP, 2000-2024

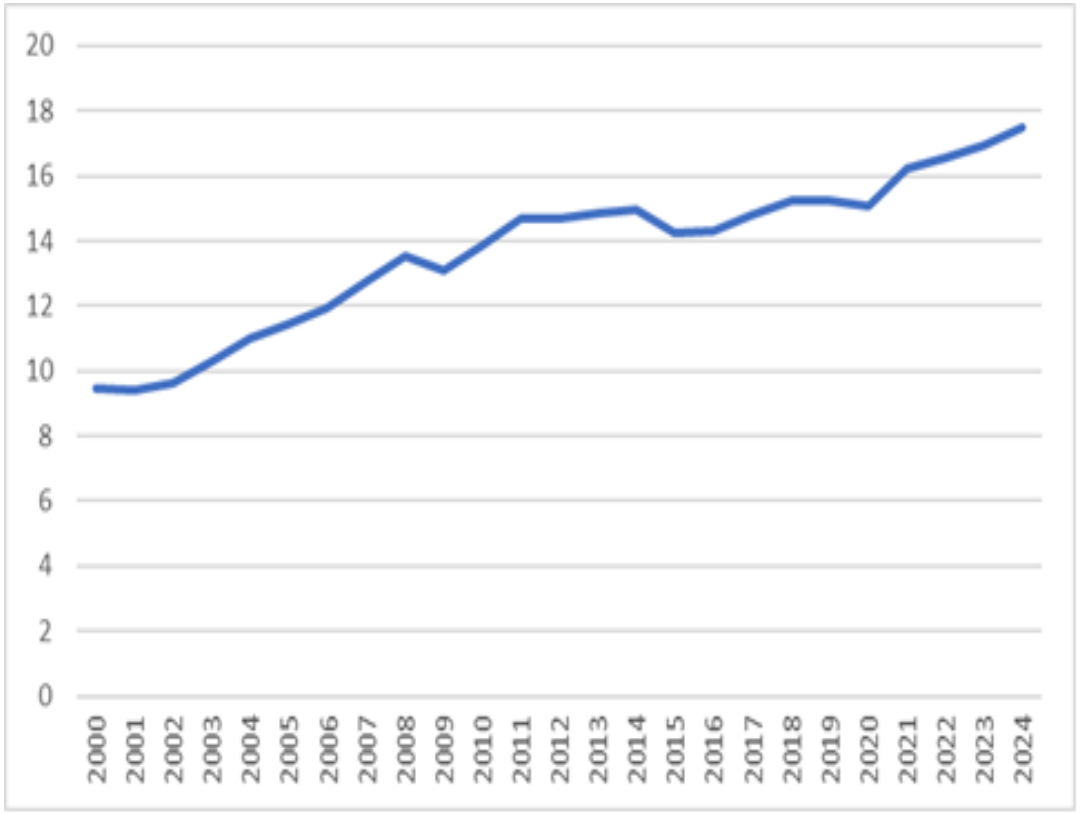


Changes in global capital, 2000-2024

RESULTS: DYNAMICS OF GLOBAL CAPITAL AND LABOUR FORCE



Changes in global labor force, 2000-2024

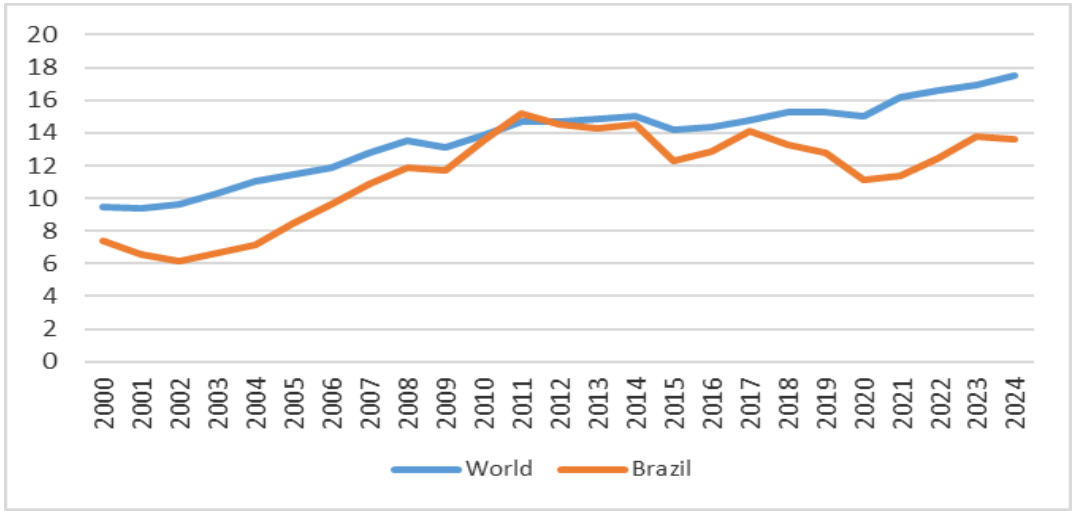


Global technological frontier, 2000-2024

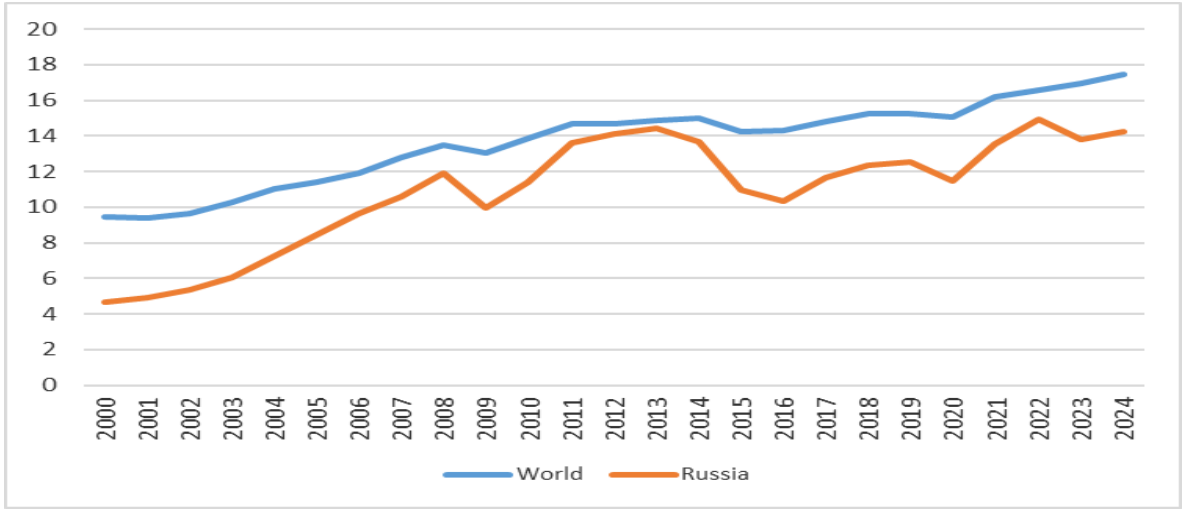
PROPOSED RANGES OF PRODUCTION FUNCTION COEFFICIENTS FOR THE BRICS COUNTRIES

Country (Code)	Range α (capital)	Range β (labor)	Brief description
China (CN)	0.40–0.45	0.55–0.60	High returns on labor, significant role of technology. When R&D is taken into account, α may be lower (0.36–0.40)
India (IN)	0.30–0.38	0.62–0.70	The macro level is labor-intensive, although in the IT sector α is locally higher
Brasil (BR)	0.35–0.42	0.58–0.65	Innovative activity is average, with mining and manufacturing industries being significant
Russia (RU)	0.40–0.48	0.52–0.60	Capital-intensive resource-based economy. When controlling for human capital, α may decrease (0.36–0.42)
South Africa (ZA)	0.35–0.42	0.58–0.65	Capital-intensive extractive industry, but overall employment is concentrated in services
Indonesia (ID)	0.32–0.40	0.60–0.68	High share of labor and informal sector
Egypt (EG)	0.30–0.38	0.62–0.70	Innovative activity is below average, labor intensity is high
Ethiopia (ET)	0.25–0.35	0.65–0.75	Early industrialization, very high labor intensity
Iran (IR)	0.38–0.48	0.52–0.62	The raw materials sector is significant, with growing R&D in some clusters

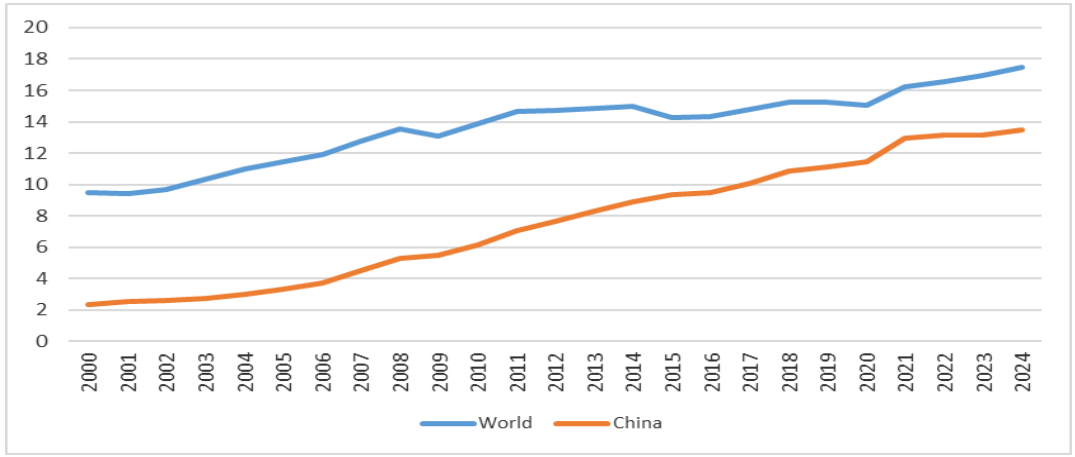
RESULTS: BRICS COUNTIRES COMPARED WITH THE GLOBAL TECHNOLOGICAL FRONITER (GTF)



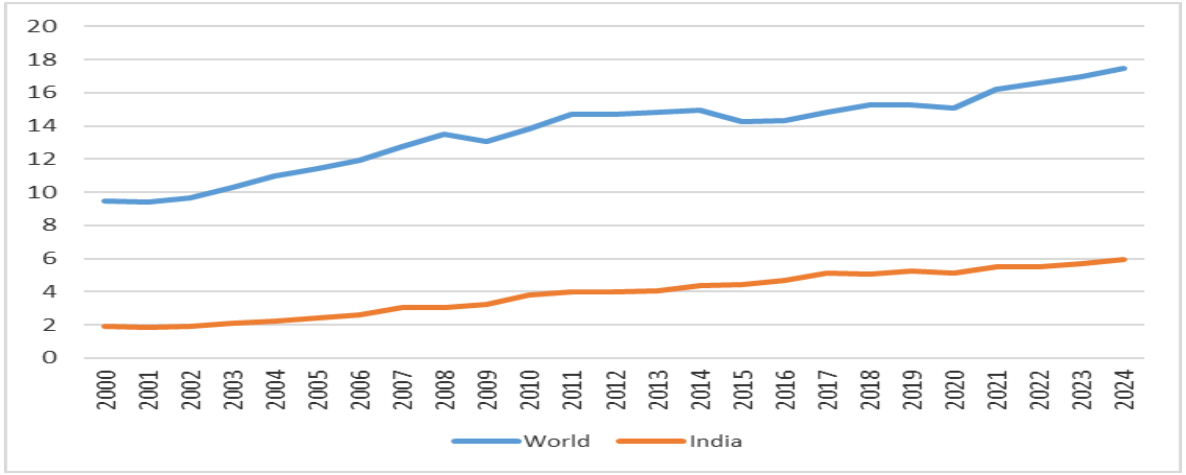
Brazil technological frontier compared with the GTF



Russia technological frontier compared with the GTF



China technological frontier compared with the GTF



India technological frontier compared with the GTF

CLUSTERS – TRAJECTORY TYPES

Cluster	Trajectory type	Countries	Average growth rate A, %	Average gap from the world frontier	Volatility	Cluster characteristics
Cl1	Technological leader (shifting the frontier)	China	+3,2%	- 0.02 (minor lead)	Low	Shifting the technological frontier, setting global standards in AI and green technologies
Cl2	Stable (with industry growth areas)	Russia, Brazil, Iran	+0,8…1, 1%	+0,12..0,18	Medium/ High	There are certain sectors with growth potential, but there is persistent stagnation
Cl3	Catch-up with acceleration	India, Indonesia	+2,4..2,7 %	+0,09…0,14	Medium	Rapid convergence with the global frontier through the IT sector, but structural heterogeneity within the national economy
Cl4	Early industrialization	Egypt, Ethoipia, South Africa	+0,4..0,6 %	+0,22…0,31	High	Generally low productivity, significant informal sector

*high α is typical for capital intensive commodity economies (Cl2), high β is typical for countries with large populations and growing industries (Cl4), and the transition to the "technology + knowledge" model (China) leads to more balanced coefficients

DISCUSSION

Some BRICS members are approaching the global technological frontier, while others are diverging significantly

China is demonstrating convergence, dominating several indicators of knowledge-intensive growth and **shifting the global technological frontier**

India, Russia, South Africa, Iran, and Indonesia exhibit **a steady, economy-wide heterogeneous lag** driven by lower innovation intensity, weak R&D productivity, and limited scaling of critical technologies - all of which slow down convergence with the global level

For India and Indonesia, the priority is to align the manufacturing sector with the service sector (high IT productivity coexists with a weak manufacturing sector)

For Russia, the key challenge is to overcome institutional and diffusion barriers that prevent industry-level breakthroughs from translating into overall technological growth

For Egypt, Ethiopia, and South Africa, the priority lies in creating and developing basic innovation infrastructure and institutions that enable the effective integration of external technologies

CONCLUSION

The BRICS countries are demonstrating **accelerated growth** in science and technology potential

The Chinese economy illustrates the ability not only to close the technological gap with global leaders, but also **to set new performance benchmarks** in a number of high-tech areas through a combination of scalable production platforms, targeted R&D investments, and deep integration into global value chains

There are **risks of technological inequality** within the BRICS and potential protectionism of national markets by stronger BRICS economies

The cluster analysis has shown that technological frontier trajectories are **not rigidly predetermined:** with targeted policy, transitions between clusters are possible

BRICS as an institution of multilateral coordination and dialogue **can act as an accelerator** of such transitions through mechanisms of technological diffusion and joint R&D projects

In this regard, **joint technology transfer centers, harmonization of patent regulation,** and **alternative forms of technological cooperation** are most promising directions

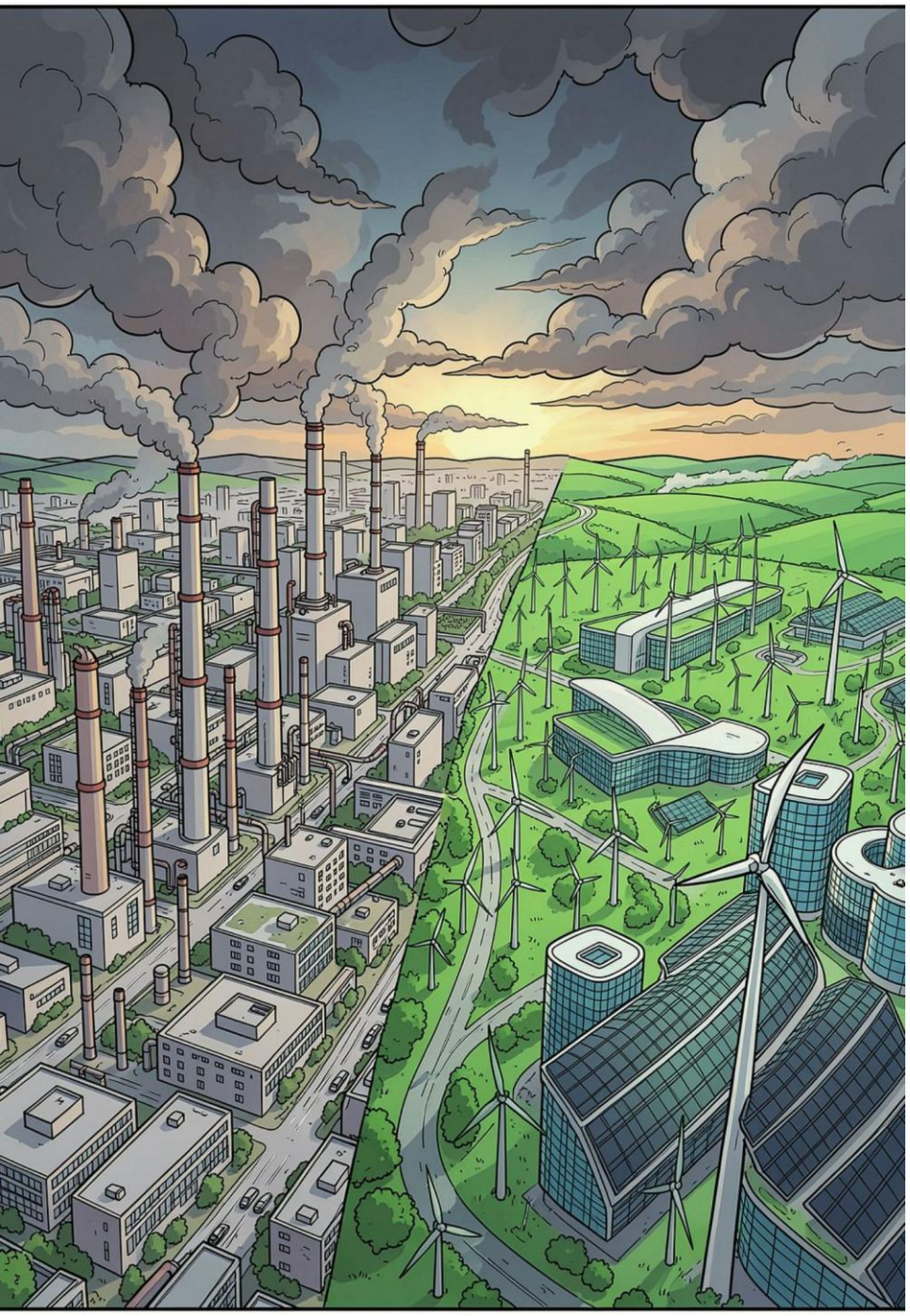
The approach depicts the complementarity of BRICS economies in technological development, can help to diversify strategic partnerships among BRICS countries, and to increase the sustainability of their national growth model in the context of global technological space fragmentation

FUTURE RESEARCH

In future, it is necessary **to test the proposed approach** to assessing technological trajectories **across a wider range of emerging economies,** primarily those with poorly structured innovation systems and limited statistical data

With the development of new analytical methods, including generative models and AI-based forecasting tools, the issue of **applying machine learning to track technological frontiers** also remains open

Also further research is important to identify the most promising ways of **implementing the proposed methodology** and the most effective digital tools **for analyzing technological sovereignty trajectories** within the BRICS



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   Abstract Submissions Deadline
2. **15 November 2026**
   Notification of Acceptance
3. **30 January 2027**
   Full Chapter Submissions
4. **15 March 2027**
   Revised Manuscript Submission

All manuscripts must be submitted via the official submission link

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