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The Impact of Digital Inequality on Economic Stability in BRICS Countries

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Abstract: Digital inequality is considered one of the main causes of socio-economic inequality and an obstacle to sustainable development in all countries, including the BRICS countries. However, empirical studies devoted to studying the impact of digital inequality on achieving sustainable development are very limited. The purpose of this study is to fill the gap in the scientific literature and conduct an analysis to identify the most significant indicators of digital inequality on socio-economic development in the BRICS countries, as well as to assess the impact of digital inequality on achieving sustainable development. Methodology: Using correlation-regression analysis and econometric modeling tools, the impact of digital infrastructure on economic stability was assessed and potential benefits of universal digital access, such as increased economic equality and sustainability, were highlighted. In this study, correlation analysis and regression models were evaluated at different levels of significance on data from 2000 to 2022 using Eviews software. Results: Mobile Cellular Subscriptions and Fixed Broadband Subscriptions affect economic development in all BRICS countries. Subscriptions to mobile cellular communications or tariffs for Internet users may have different effects when studied in more detail or with a focus on specific sectors. New incentive instruments are needed to increase the import of ICT goods, this contributes to technological development. Support programs for start-ups and small businesses offering ICT services need to be expanded. An important area for creating new economic opportunities is stimulating the export of high-value or innovative ICT goods. Implementation of the proposed recommendations can help bridge the digital divide and promote economic stability and growth. Originality: This study examines the level of influence of digital inequality on economic stability in BRICS countries. In addition, the proposed recommendations will help reduce digital inequality in terms of its contribution to achieving sustainable development.

1 INTRODUCTION

The widespread implementation of digital technologies and access to the Internet has significantly changed the way people live around the world, creating new opportunities and contributing to the economic growth. In the context of digital transformation, which encompasses all spheres of life, it is noticeable how technology has an immediate impact on the social, economic and cultural structures of society. It is important to note that along with positive changes such as increased productivity and improved accessibility of services, a number of serious challenges related to digital inequality are emerging.

The BRICS countries show diversity in their level of economic development and implementation of digital technologies. For example, while Brazil and South Africa are actively developing their digital economies and startup cultures, India faces infrastructure deficits and high levels of disparities in access to internet resources. Digital inequality in this context can be seen as a complex phenomenon that reflects not only differences in physical access to

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technologies, but also implies the skills required to use these technologies effectively at the individual and community level.

There is a growing awareness of the need to address the digital divide at the level of states and international organisations. This includes investment in infrastructure, training and retraining programmes, and policy development to create a more inclusive digital space. The future of economies depends on how well states can integrate digital technologies in a way that takes into account the needs of all segments of society, ensuring equal access to resources and opportunities.

The purpose of this study is to examine various aspects of the digital divide in the BRICS countries, exploring how it affects economic performance, social equity and overall national progress. An attempt is made to find the common trends and differences of digital inequality in BRICS countries. Analysing the current state of digital access and its implications for economic stability, it highlights the urgent need for inclusive policies for each of the BRICS countries to bridge the digital divide and contribute to a more equitable digital ecosystem.

Through a comprehensive review of existing literature, analysing statistical data and case studies, the challenges associated with digital inequality have been addressed and potential strategies have been proposed to improve access, increase digital literacy and ultimately achieve more stable economies in the BRICS countries. By addressing these important issues, this article seeks to contribute to a nuanced understanding of the relationship between technology and socio-economic stability, offering ideas for future initiatives aimed at achieving digital equality.

2 LITERATURE REVIEW

The literature review explores the relationship between the digital divide and economic stability, summarising key findings from various studies. The use of digital technologies has significantly improved educational outcomes, labour force engagement, income levels, and quality of life through rapid access to information and reduced transaction costs (Rusch et al., 2023). Digital inclusion has revolutionised industries such as finance, healthcare, agriculture, transport and management (Suhrab et al., 2024). Telemedicine is rapidly gaining momentum, increasing accessibility to healthcare services, precision farming increases crop yields, smart transport reduces congestion, and e-government improves citizen interaction and service delivery (Costa et al., 2023; Singh, 2023). These advances are transforming communities, economies, and leadership, shaping a more connected and diverse future. It also helps improve decision making, efficiency, innovation, and market expansion for businesses (Al-Emran & Griffy-Brown, 2023; Domeher et al., 2022).

The digital divide can be categorised into several dimensions including access, utilisation and skills. According to Van Dijk, access refers to the physical availability of technology, while skills are decisive for navigating the digital landscape, and differences in these areas can lead to unequal economic outcomes, which is an important component in shaping competitiveness in the labour market (Van Dijk, 2017).

Digital inequality is considered in the academic literature as a complex phenomenon that includes limited physical access to telecommunication infrastructure, lack of necessary competences and low utilisation of digital capabilities (Kuhn et al., 2023). According to the authors digital inequality in BRICS countries is a multifactorial problem, and the causes of digital inequality in each BRICS country can be both unique and recurrent (Lazanyuk et al., 2025).

Limited access to the global network leads to many significant constraints, which ultimately affects the quality of life. First of all, lack of access to the Internet negatively affects educational opportunities. Poorly educated people use the Internet less often, which limits them in obtaining a higher level of education, which in turn leads to the so-called "feedback loop". Consequently, inequality reproduces itself, causing an accumulated advantage effect (Gulina & Musina, 2024).

Similarly, in health care access to online services such as telemedicine and electronic health records is becoming an important factor in receiving quality health care (Troyan et al., 2023). Limited online access means that people may not receive timely information about preventive procedures, relevant research, or new treatments, which may lead to a deterioration in their health.

In terms of public services, the process of obtaining necessary documents and seeking help is often now done through digital platforms. People with limited access to the internet may find it difficult to apply for these services, leading to more bureaucracy and difficulties in realising their rights (Platonova, 2024).

In addition, all of this has a negative impact on the labour market. Lack of internet access becomes a significant barrier to employment with many jobs requiring basic digital skills. Lack of digital competences not only reduces the chances of successful employment, but also limits career opportunities and professional development (Lazanyuk et al., 2025).

Digital inequality in the BRICS countries is expressed in different forms and has diverse implications for the social and economic development of these countries.

In Brazil, digital inequality is highly dependent on geographical location and socioeconomic status. In large cities such as São Paulo and Rio de Janeiro, access to Internet technology is high, but in remote and rural areas such as the northeastern regions, people often face a lack of quality Internet and digital infrastructure. The consequence of this is increased inequality in education and consequently uneven employment chances (de Souza Cruz Ravaglio et al., 2023).

In South Africa, the problem of digital inequality is exacerbated by racial and economic factors. Part of the population, especially in suburban and rural areas, continues to be without access to basic digital services, reinforcing already existing social inequalities. Poor access to the internet hinders educational programmes, which in turn leads to a worsening economic situation in regions with low levels of digital literacy and high unemployment. In addition, lack of access to information on employment opportunities and financial services exacerbates cyclical poverty. The digital divide hinders the development of small and medium-sized enterprises (Mbatha, 2024).

In Russia, the digital divide is evident in the differences between urban and rural settlements, as well as by region. In megacities such as Moscow and St. Petersburg, high levels of digitalisation and infrastructure allow residents to access various online services. However, in less developed regions, people face problems with slow internet and a lack of digital skills. This limits their access to education, health services and opportunities for self-employment. The consequences are not only a deterioration in the quality of life but also a drag on the overall economic growth of the country as the lack of digital skills among a large section of the population reduces their competitiveness in the labour market (Chereshnia & Gribok, 2023).

Digital inequality in India and China is an important topic as both countries represent two of the largest emerging markets in the world with huge potential for digital transformation. Despite significant advances in technology and internet access, large gaps in digital and internet access continue to exist, determining the economic and social opportunities of the population.

India faces several dimensions of digital divide. First, there is a significant difference in internet access between urban and rural areas. In large cities such as Mumbai and Delhi, access to high-speed internet and digital services is much greater than in remote and rural areas. In addition, India has a serious digital literacy problem even among the youth (Ray, 2025). Even with access to the internet, many people lack the necessary skills to use digital technologies effectively, which limits their ability to learn and work. The availability of multilingual content also becomes a barrier: many Indians are not proficient in the language in which the main online resources are presented. On the other hand, China has shown impressive progress in increasing digitalisation. According to official statistics, more than 900 million Chinese have access to the internet. However, this does not mean that the digital divide has been completely eliminated. Differences in internet access and digitalisation still exist, especially between the eastern and western regions of the country (Shou & Zhou, 2025). Eastern provinces such as Shanghai and Beijing are developing much faster than many western regions, leading to social and economic gaps. In addition, like India, China has a digital literacy problem. Supporting the idea of a 'smart society', the government emphasises digital skills, but many elderly and younger people in rural areas are lagging behind in their learning, limiting their access to employment opportunities and social inclusion. Thus, the BRICS countries, despite advances in digitalisation, face serious challenges related to digital inequality. These inequalities can have profound implications for economic and social development, hindering people's access to education, health and other important services. Effective measures are needed to address these gaps, such as infrastructure improvements, educational programmes on digital literacy and technology accessibility. Equally important is the monitoring and evaluation of programmes aimed at reducing the digital divide. Effective mechanisms for collecting and analysing data will help to understand what progress has been made, which methods are working best and where adjustments are needed. It will also enable the involvement of stakeholders who can provide valuable information and recommendations based on real-life experience. Thus, researching the factors of digital transformation and its impact on socio-economic processes, as well as developing recommendations to reduce the digital divide, is an important issue that has the potential to improve the

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quality of life of a large part of the population and contribute to a more equitable and sustainable development (Perera, et al., 2023) of society as a whole.

3 RESEARCH METHODOLOGY

The aim of the article is to identify the main factors contributing to digital access and disconnection in BRICS countries. Using correlation and regression analysis and econometric modelling tools, the impact of digital infrastructure on economic stability was assessed and the potential benefits of universal digital access, such as increased economic equality and sustainability, were highlighted. In this study, correlation analysis and regression models were estimated at different levels of significance on data from 2000 to 2022 using Eviews software. The list of dependent and independent variables used and the source from which the data were obtained are presented below:

Dependent variable is GDP per capita, PPP (in dollars, constant 2021 prices), independent variables are:

mobile cellular subscribers (per 100 people),

fixed broadband subscribers (per 100 people),

fixed broadband subscribers (per 100 people),

fixed telephone subscribers (per 100 persons),

imports of ICT goods (% of total imports of goods),

exports of ICT services (% of exports of services, balance of payments, exports of ICT goods (% of total exports of goods)

Internet users (% of population).

Table 1: Details of Dependent and Independent Variables and the source from where data is obtained.

Y - GDP per capita, PPP (current international dollar) Source: World Bank https://data.worldbank.org/indicator/NY.GDP.PCAP.PP.CD
X1 - Mobile cellular subscriptions (per 100 people) Source: World Bank https://data.worldbank.org/indicator/IT.CEL.SETS.P2?view=chart
X2 - Fixed broadband subscriptions (per 100 people) Source: World Bank https://data.worldbank.org/indicator/IT.NET.BBND.P2?view=chart
X3 - Fixed telephone subscriptions (per 100 people) Source: World Bank https://data.worldbank.org/indicator/IT.MLT.MAIN.P2?view=chart
X4 - ICT goods imports (% of total goods imports) https://data.worldbank.org/indicator/TM.VAL.ICTG.ZS.UN?view=chart
X5 - ICT services exports (% of services exports, BoP) Source: World Bank https://data.worldbank.org/indicator/BX.GSR.CCIS.ZS?view=chart
X6 - ICT goods exports (% of total goods exports) https://data.worldbank.org/indicator/TX.VAL.ICTG.ZS.UN?view=chart
X7 - Internet users (% of population) Source: World Bank https://data.worldbank.org/indicator/IT.NET.USER.ZS

4 FINDINGS AND DISCUSSIONS

Findings from the analysis of digital divide indicators in Russia

Table 1: Correlation Matrix.

Correlation Probability	Y	X1	X2	X3	X4	X5	X6	X7
X1	0.853327	1.000000						
	0.0000							
X2	0.945810	0.817542	1.000000					
	0.0000	0.0000						
X3	-0.563376	-0.156946	-0.641609	1.000000				
	0.0097	0.5087	0.0023					
X4	0.754532	0.724970	0.709914	-0.499632	1.000000			
	0.0001	0.0003	0.0005	0.0249				
X5	0.909756	0.676234	0.878265	-0.760724	0.795037	1.000000		

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	0.0000	0.0011	0.0000	0.0001	0.0000			
X6	0.600809	0.481277	0.749134	-0.595819	0.465952	0.618741	1.000000	
	0.0051	0.0317	0.0001	0.0056	0.0384	0.0036		
X7	0.953937	0.855294	0.992603	-0.566288	0.694151	0.850562	0.716550	1.000000
	0.0000	0.0000	0.0000	0.0092	0.0007	0.0000	0.0004	

Results of the correlation analysis of the pair correlation matrix, interpretation of calculations and some main conclusions:

Strong positive correlation with GDP per capita

1. Internet users (X7) (r=0.95, p=0.00), a high percentage of Internet users is strongly correlated with GDP per capita, probably because of the role of Internet access in promoting economic participation and productivity.

2.Fixed broadband subscriptions (X2) (r=0.95; p=0.00), reflecting well-developed telecommunication services, broadband Internet availability and confirming the importance of high quality Internet infrastructure for economic growth.

3. Exports of ICT services (X5) (r=0.91; p=0.00), the high positive correlation suggests that exports of ICT goods can strongly influence GDP per capita. However, globally, Russia is not even among the top ten exporting countries. The share of foreign sales of IT companies in Russia's total exports in 2022 was only 1.2 versus 2.3 per cent in 2020, according to Russoft. However, according to The World Bank Group, the country ranked second in terms of IT exports among the post-Soviet states in 2022 ($5.8bn).

4. Mobile cellular subscriptions (X1) (r=0.85; p=0.00), the correlation coefficient indicates high availability of communication services and developed communication infrastructure.

5. Imports of ICT goods (X4) (r=0.75, p=0.00), the positive strong correlation implies that higher imports of ICT goods may be associated with Russia's economic growth, possibly because these goods support technological infrastructure, but this may be quite risky given current international market conditions. Until 2022, Russia's ICT sector was heavily import-orientated, accounting for up to $35bn a year. However, since 2022, the course towards technological sovereignty has become a priority, which leads to reduced dependence on imports.

Moderate correlation with GDP per capita

1. Exports of ICT goods (X6) (r=0.60; p=0.00), this positive but moderate correlation implies that Russian exports of ICT goods can make a significant contribution to the country's economy. The demand for Russian ICT products comes largely from government agencies. Russia has developed a set of tools to realise a large-scale ICT export project.

2. Fixed telephone subscriptions (X3) (r=-0.56; p=0.01), the negative correlation is a consequence of technology obsolescence and declining demand.

In the next stage of the study, several econometric models were estimated to identify the most significant variables affecting GDP per capita. Table 2 presents the models with all coefficients statistically significant at the 1% level.

Table 2: Comparative results of econometric models for Russia.

Метрика / Факторы	Номер модели	Adjusted R-squared	S.E. of regression	Sum squared resid	Akaike info criterion	Schwarz criterion	MAPE
X1, X2	Model 1	0,9251	1271,998	27505641	17,27205	17,42141	2,806
X1, X7	Model 2	0,9322	1210,16	24896269	17,17237	17,32173	2,635
X2, X7	Model 3	0,8817	1602,542	46226556	17,72813	17,87735	3,403
X2,X5,X7	Model 4	0,8803	1612,076	44179417	17,77808	17,97703	3,511

Model Fit Summary

Comparing the models, we used standard criteria to compare models of similar specification. As shown in Table 2, the best model was model №2:

$$Y = 22444.52 + 58.46 * X1 + 63.86 * X7,$$

N=21

- The adjusted R² = 0.9322 indicates a very high correlation between the predictors and GDP per capita even after adjustment and means that approximately 93.22% of the variance of GDP per capita is explained by the predictors included in this model.

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- All other models presented in the table have less favourable results.

It can be noted that based on the linear relationship obtained, it can be stated that an increase in the number of mobile cellular subscribers per 100 people of the Russian population will increase the average GDP per capita in purchasing power parity by $58.46 per year. While fixed broadband contracts per 100 people will increase the average GDP per capita at purchasing power parity by $63.86 per year.

Thus, the modelling results confirmed the importance of developing communications infrastructure and access to high-speed internet, which is relevant in the context of sustainable economic growth. Despite the high correlation values, the influence of such factors as X4 - Import of ICT goods, X5 - Export of ICT services and X6 - Export of ICT goods on GDP per capita was not revealed in the models.

Findings from the analysis of digital divide indicators in China

Table 3: Correlation Matrix.

Correlation Probability	Y	X1	X2	X3	X4	X5	X6	X7
X1	0.988633	1.000000						
	0.0000							
X2	0.984266	0.950945	1.000000					
	0.0000	0.0000						
X3	-0.823074	-0.802657	-0.841524	1.000000				
	0.0000	0.0000	0.0000					
X4	-0.131250	-0.218267	-0.015548	0.092549	1.000000			
	0.5706	0.3419	0.9467	0.6899				
X5	0.984109	0.973924	0.975023	-0.833610	-0.039527	1.000000		
	0.0000	0.0000	0.0000	0.0000	0.8649			
X6	-0.575636	-0.536783	-0.591045	0.776154	0.306961	-0.528527	1.000000	
	0.0063	0.0121	0.0048	0.0000	0.1759	0.0138		
X7	0.991950	0.992149	0.961187	-0.818873	-0.224526	0.974541	-0.585241	1.000000
	0.0000	0.0000	0.0000	0.0000	0.3278	0.0000	0.0053	

There is an analysis of the coefficients of the pairwise correlation matrix, interpretation of the calculations and some key findings:

Strong positive correlation with GDP per capita

1. Mobile cellular subscriptions (X1) (r=0.99; p=0.00), the correlation coefficient is significantly higher than this indicator for other BRICS countries. This indicates high availability of communication services and developed communication infrastructure.

2. Internet users (X7) (r=0.99, p=0.00), high percentage of Internet users is strongly correlated with GDP per capita, probably due to the role of Internet access in promoting economic participation and productivity.

3. Fixed broadband subscriptions (X2) (r=0.98; p=0.00), reflecting well-developed telecommunication services, broadband Internet availability and confirming the importance of high-quality Internet infrastructure for economic growth.

4. Export of ICT services (X5) (r=0.98; p=0.00), the high correlation suggests that export of ICT goods can strongly affect GDP per capita, the positive correlation indicates that China is successful in exporting ICT services.

Strong negative correlation with GDP per capita

5. Fixed telephone subscriptions (X3) (r=-0.82; p=0.00), the negative correlation is a consequence of technology obsolescence and declining demand for it possibly because richer economies rely more on mobile and broadband services instead of traditional telephony.

Moderate correlation with GDP per capita

6. Exports of ICT goods (X6) (r=-0.58; p=0.00), this negative but moderate correlation implies that over-reliance on exports of ICT goods may make the economy vulnerable to changes in global demand.

Calculations showed that there is a low or insignificant correlation between GDP per capita and **imports of ICT goods (X4) (r=-0.13; p=0.57),** it can be concluded that China, being one of the largest producers of information and communication technology, is not dependent on foreign suppliers.

In the next stage of the study, several econometric models were estimated to identify the most significant variables affecting GDP per capita. Econometric modelling tools allow us to quantify the relationship between China's economic performance and interventions aimed at ensuring the reduction of the digital divide. Table 4 presents only those models in which all coefficients are statistically significant at the 1% level.

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Table 4: Comparative results of econometric models for China.

Метрика \ Факторы	Номер модели	Adjusted R-squared	S.E. of regression	Sum squared resid	Akaike info criterion	Schwarz criterion	MAPE
X1, X2	Model 1	0,9975	263,6316	1251029	14,1185	14,2678	1,836
X1, X4	Model 2	0,9832	682,1237	8375271	16,0199	16,1691	3,992
X1, X5	Model 3	0,9846	652,7269	7668943	15,9376	16,081	3,326
X2, X4	Model 4	0,9803	740,0227	9857406	16,1828	16,332	5,697
X2, X5	Model 5	0,9788	767,641	10606909	16,2561	16,4053	5,978
X2, X7	Model 6	0,9964	331,1924	1974391	14,5748	14,7241	2,773
X4, X5	Model 7	0,9745	841,5952	12749085	16,44	16,5893	5,132
X4, X7	Model 8	0,9927	471,8254	4007146	15,2827	15,4319	2,888

Model Fit Summary

In comparing the models, we used standard criteria to compare models of similar specification. As shown in Table 4, the best model was model 1:

$Y = 3433.21 + 77.81 * X1 + 186.21 * X2$,

N=21

- **The adjusted R² = 0.9975** indicates a very high correlation between the predictors and GDP per capita even after adjustment and means that approximately 99.75% of the variance in GDP per capita is explained by the predictors.

- All other criteria presented in the table are lower than those in other models.

It can be noted that based on the linear relationship obtained, it can be argued that an increase in the number of mobile cellular subscriptions per 100 population in China will increase the average GDP per capita in purchasing power parity by $77.81 per year. While fixed broadband contracts per 100 people will increase the average per capita GDP at purchasing power parity by $186.21 per year.

The modelling results thus confirmed the importance of developing communications infrastructure and access to high-speed internet, which is relevant in the context of sustainable economic growth. However, there is also a need to enhance the development of digital skills, this in turn will enable better services for the population, not only the growth of e-commerce, but also access to government services, education, healthcare, etc. Access to quality connectivity helps to optimise business processes, and expand opportunities for SMEs. However, a significant increase in ICT imports may expose China's economy to certain risks. With instability in global markets and fluctuations in technology prices, dependence on imports can lead to vulnerabilities in the economic system. In addition, such dependence increases vulnerability to competitors.

Findings from the analysis of digital divide indicators in India

Table 5: Correlation Matrix.

Correlation Probability	Y	X1	X2	X3	X4	X5	X6	X7
X1	0.913562	1.000000						
	0.0000							
X2	0.950475	0.924407	1.000000					
	0.0000	0.0000						
X3	-0.933778	-0.963027	-0.905541	1.000000				
	0.0000	0.0000	0.0000					
X4	0.487492	0.289671	0.306941	-0.389251	1.000000			
	0.0250	0.2028	0.1759	0.0811				
X5	-0.103186	-0.050909	0.056057	-0.001337	-0.060585	1.000000		
	0.6563	0.8265	0.8093	0.9954	0.7942			
X6	0.172461	0.163831	0.306635	-0.110792	0.014204	0.443635	1.000000	
	0.4547	0.4779	0.1764	0.6326	0.9513	0.0440		
X7	0.871562	0.687979	0.887375	-0.733290	0.473240	0.100507	0.385722	1.000000
	0.0000	0.0006	0.0000	0.0002	0.0303	0.6647	0.0842	

These is an analysis of the coefficients of the pairwise correlation matrix, interpretation of the calculations and some key conclusions:

Strong positive correlation of GDP per capita

1. Fixed broadband subscriptions (X2) (r=0.95, p=0.00), indicating the sophistication of telecoms services and broadband internet availability and confirming the importance of high quality internet infrastructure for economic growth.

2. Mobile cellular subscriptions (X1) (r=0.91; p=0.00), which indicates high availability of communication services and developed communication infrastructure.

3. Internet users (X7) (r=0.87, p=0.00), similarly, a high percentage of Internet users is closely related to GDP per capita, probably because of the role of Internet access in promoting economic participation and productivity, but it does not reflect the level of digital literacy. The proportion of the population using the Internet is reflected in growth.

Negative correlation of GDP per capita

4. Fixed telephone subscriptions (X3) (r=-0.93, p=0.00), the negative correlation is a consequence of technology obsolescence and declining demand for the fixed-line network, but also shows that its share is still quite high.

Moderate correlation of GDP per capita

5. Imports of ICT goods (X4) (r = 0.49, p = 0.05), the positive but moderate correlation implies that higher imports of ICT goods may be associated with economic growth, possibly because these goods support technological infrastructure, and it may also be quite risky given current international market conditions.

6. Exports of ICT goods (X6) (r = 0.17, p = 0.45), the insignificant correlation suggests that exports of ICT goods may not have as strong an impact on GDP per capita as imports, which may be due to the nature of the goods exported or the level of value-added processes within the country.

Low or insignificant correlation of GDP per capita

7. Exports of ICT services (X5) (r = -0.103, p = 0.66), the lack of correlation here may indicate competitive pressures or external dependence in ICT services. Potential outsourcing effects, in the case of large Indian exporters, which relies on cheaper labour or investment in infrastructure abroad, the economic benefits at home may be limited.

The development of digital infrastructure, high-speed internet and an increase in the number of internet users have contributed to sustained economic growth. The variable (year) shows a strong positive correlation with several predictors, including GDP per capita (r = 0.981, p < 0.001), indicating that GDP and ICT indicators tend to increase each year. This is in line with the general trends of increasing ICT adoption and economic growth.

Recommendation: Develop policies to make the Internet more accessible to the general population, as a high percentage of Internet users is strongly associated with higher GDP per capita (r = 0.938).

Table 6 presents the results of the econometric modelling for India, as well as for other countries the models whose equations are statistically significant at the level of 1% or less are presented.

Table 6: Comparative results of econometric models for India.

Metrics / Factors	Model number	Adjusted R-squared	S.E. of regression	Sum squared resid	Akaike info criterion	Schwarz criterion	MAPE
X1, X4	Model 1	0.876457	590.3803	6273880	15.73097	15.88019	6.974154
X1, X7	Model 2	0.940841	408.5388	3004272	14.99461	15.14383	5.267553
X2, X4	Model 4	0.939675	412.5445	3063474	15.01413	15.01413	5.330830
X2, X5	Model 5	0.919958	475.2078	4064804	15.29694	15.29694	6.004619
X2, X6	Model 6	0.910034	503.8060	4568769	15.41382	15.56304	5.895685
X5, X7	Model 7	0.773767	798.9172	11488836	16.33596	16.48517	12.38572

Model Fit Summary

Standard criteria were used to compare models of similar specification. As can be seen in Table 6, model 2 was the best as it had the lowest MAPE score, thus this approximation is better compared to the other models evaluated on the available data:

$Y = 2418.49 + 24.94 * X1 + 76.27 * X7$,

N=21

- **The adjusted R^2=0.9408** indicates a high correlation between the predictors and GDP per capita even after adjustment and means that approximately 94.08% of the variance of GDP per capita is explained by the predictors.
- Statistically significance at p-value of 0.01 this predictor is significant at the 2% level, indicating that there is a high probability that this positive relationship is not due to chance. It may be noted that based on the linear relationship obtained, it can be stated that an increase in the number of mobile cellular subscribers per 100 population in India will increase the average per capita GDP at purchasing

power parity by $24.94 per annum, holding other variables constant. While an increase in internet users by 1 per cent will increase the average per capita GDP at purchasing power parity by $76.27 per annum.

Thus, the modelling results confirmed the importance of developing communications infrastructure and access to high-speed internet, which is relevant in the context of sustainable economic growth. There is a need to develop policies to make the Internet more affordable to the general population, as a high percentage of Internet users is strongly associated with higher GDP per capita. Increased broadband connectivity is likely to improve the flow of information, make e-commerce accessible, facilitate remote working and support the development of digital skills, all of which contribute to economic stability and sustained growth. For policymakers, this finding suggests that investment in broadband infrastructure can be a key driver of a country's economic development.

Findings from the analysis of digital divide indicators in Brazil

Table 7: Correlation Matrix.

Correlation Probability	Y	X1	X2	X3	X4	X5	X6	X7
X1	0.971425	1.000000						
	0.0000							
X2	0.749109	0.709974	1.000000					
	0.0001	0.0003						
X3	-0.203926	-0.104111	-0.752906	1.000000				
	0.3753	0.6534	0.0001					
X4	-0.664190	-0.606213	-0.674580	0.339302	1.000000			
	0.0010	0.0036	0.0008	0.1324				
X5	0.272552	0.220237	0.826851	-0.924757	-0.473517	1.000000		
	0.2320	0.3374	0.0000	0.0000	0.0301			
X6	-0.907107	-0.898645	-0.887584	0.424277	0.685077	-0.541635	1.000000	
	0.0000	0.0000	0.0000	0.0552	0.0006	0.0112		
X7	0.752836	0.725198	0.986878	-0.730508	-0.591833	0.795931	-0.901049	1.000000
	0.0001	0.0002	0.0000	0.0002	0.0047	0.0000	0.0000	

Results of the correlation analysis of the pair correlation matrix, interpretation of calculations and some main conclusions:

Strong positive correlation of GDP per capita

1. **Mobile cellular subscriptions (X1) (r=0,971; p=0.00)**, a high correlation coefficient indicates a fairly developed communications infrastructure, despite the limited access to communications services in rural areas.
2. **Fixed broadband subscriptions (X2) (r=0,749; p=0.00),** which reflects well-developed telecommunications services, availability of broadband Internet and confirms the understanding of the importance of high-quality Internet infrastructure for the country's economic growth.
3. **Internet users (X7) (r=0,752, p=0,00),** The high correlation coefficient shows a close relationship between Internet users and GDP per capita. The number of Internet users in Brazil in 2022 was 80.5%, more than in China (75.6%), South Africa (75.5%), India (55.9%), Russia (90.4%), which demonstrates good dynamics compared to other BRICS countries. However, the question of the population's level of digital skills remains open.

Strong Negative correlation of GDP per capita

4. **Exports of ICT goods (X6) (r=-0,907; p=0.00),** The strong negative correlation implies that Brazil is not a significant exporter of ICT goods. ICT goods exports reached a historical maximum of 3,961,766,182 thousand US dollars in 2006 and a record low of 666,160,588 thousand US dollars in 2020. ICT goods exports in December 2022 amounted to 889,649,988 thousand US dollars, which is comparable only with South Africa (867,942,467 thousand US dollars) in the context of BRICS countries, China's exports in the same year amounted to 813,552,114,300 thousand US dollars, in India 12,530,029,080 thousand US dollars, in Russia 2,563,595,237 thousand US dollars.
5. **Imports of ICT goods (X4) (r = -0,664, p = 0,00),** a strong negative correlation implies that higher ICT imports may be associated with economic growth, perhaps because these goods support the technological infrastructure, but it also shows the strong dependence of the Brazilian economy on ICT imports. However, since 2023, Brazil's economic policy has entered a phase associated with strengthening the role of the state in ensuring a technological breakthrough. One of the elements of this policy is to reduce the country's dependence on equipment imports in basic industries, stimulate the implementation of its own R&D, and ensure technological and digital sovereignty.

As calculations have shown, the correlation between the factors **Fixed telephone subscriptions (X3)** and **Export of ICT services (X5)** with GDP per capita according to PPP has not been identified, the

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correlation coefficients are statistically insignificant even at the 10% significance level.

Table 8 presents the results of econometric modeling for Brazil, as well as for other countries, models whose equations are statistically significant at a level no higher than 1%.

Table 8: Comparative results of econometric models for Brazil.

Метрика / Факторы	Model number	Adjusted R-squared	S.E. of regression	Sum squared resid	Akaike info criterion	Schwarz criterion	MAPE
X2, X5	Model 1	0.934990	397.1278	2838788	14.93796	15.08717	1.748774
X1, X4	Model 2	0.947367	357.3290	2298312	14.72675	14.87597	1.524269
X5, X6	Model 4	0.878413	543.1051	5309336	15.56405	15.71326	2.353082
X5, X7	Model 5	0.842121	618.8755	6894124	15.82525	15.97447	2.842850

Model Fit Summary

When comparing the models, standard criteria were also used, allowing comparison of models with similar specifications. As can be seen from Table 6, model 2 turned out to be the best, since its MAPE indicator was the lowest, thus, this approximation is better compared to other estimated models according to the available data.:

$Y = 15120.98 + 39.36 * X1 - 147.64 * X4$,

N=21

- **The adjusted R^2=0.9474** indicates a high correlation between the predictors and GDP per capita even after adjustment and means that approximately 94.74% of the variance of GDP per capita is explained by the predictors.
- Statistically significant at a p-value of 0.08, this predictor is significant at the 10% level, indicating that this positive relationship is not due to chance. It can be noted that based on the linear relationship obtained, it can be argued that an increase in the number of mobile cellular subscribers per 100 people in Brazil will increase the average GDP per capita at purchasing power parity by $39.36 per year, holding other variables constant. While an increase in ICT imports will lead to a decrease in GDP per capita at purchasing power parity by $147.64 per year.

Thus, the simulation results confirmed the importance of developing communications infrastructure and access to high-speed Internet in Brazil, which is relevant in the context of sustainable economic growth. In many economies, mobile phone penetration is already very high, which leads to a decrease in marginal returns in terms of economic impact. The beginning of the stage associated with strengthening the role of the state in ensuring a technological breakthrough is timely. Reducing the country's dependence on equipment imports in basic industries, stimulating the implementation of its own R&D, ensuring technological and digital sovereignty is essential for the country to develop sustainably.

Findings from the analysis of digital divide indicators in South Africa

Table 9: Correlation Matrix.

Correlation Probability	Y	X1	X2	X3	X4	X5	X6	X7
X1	0.746241	1.000000						
	0.0001							
X2	0.709279	0.921751	1.000000					
	0.0003	0.0000						
X3	-0.279139	-0.802799	-0.758866	1.000000				
	0.2204	0.0000	0.0001					
X4	-0.751453	-0.815643	-0.809486	0.643048	1.000000			
	0.0001	0.0000	0.0000	0.0017				
X5	0.067625	0.648099	0.602928	-0.883771	-0.489937	1.000000		
	0.7709	0.0015	0.0038	0.0000	0.0242			
X6	-0.352564	-0.661629	-0.521493	0.744358	0.668848	-0.743923	1.000000	
	0.1170	0.0011	0.0153	0.0001	0.0009	0.0001		
X7	0.499011	0.937055	0.875205	-0.901421	-0.721847	0.773989	-0.669671	1.000000
	0.0213	0.0000	0.0000	0.0000	0.0002	0.0000	0.0009	

Results of the correlation analysis of the pair correlation matrix, interpretation of calculations and some main conclusions:

Strong positive correlation of GDP per capita

1. Mobile cellular subscriptions (X1) (r=0,746; p=0.00), the correlation coefficient is the lowest of all BRICS countries. This indicates an underdeveloped communications infrastructure or limited availability of communications services; in rural areas, access to the Internet and mobile communications is limited or completely absent.

2. Fixed broadband subscriptions (X2) (r=0,709; p=0.00), reflecting well-developed telecommunications services, but the impact on economic development may be weak. In 2023, South Africa had 43.48 million internet users and an internet penetration rate of 75.5 percent, which is quite low and indicates the need to accelerate the adoption and use of digital technologies in South Africa.

Strong Negative correlation of GDP per capita

3. Imports of ICT goods (X4) (r = -0,751, p = 0,00), a strong negative correlation implies that higher ICT imports may be related to the need to support the development of technological infrastructure. Since 2023, Brazil's economic policy has entered a phase associated with strengthening the role of the state in ensuring a technological breakthrough. One of the elements of this policy is to reduce the country's dependence on equipment imports in basic industries, stimulate the implementation of its own R&D, and ensure technological and digital sovereignty.

Moderate correlation with GDP per capita

4. Internet users (X7) (r=0,499, p=0,02), the coefficient is positive, significant at the 5% level, a moderate percentage of Internet users is associated with GDP per capita. The number of Internet users in South Africa in 2022 was 75.5%, which shows promising growth opportunities. It is the only country in BRICS where this coefficient is significantly lower compared to other members of the alliance.

As calculations have shown, the influence of other factors **Fixed telephone subscriptions (X3)**, **ICT services exports (X5)** and **ICT goods exports (X6)** do not have a significant impact on GDP per capita in PPP, the correlation coefficients are statistically insignificant even at the 10% significance level. In general, the analysis of the pair correlation matrix for South Africa showed that the values differ from other BRICS countries in that the dependence indicators are lower than for other countries. This indicates an underdeveloped infrastructure and low citizen engagement in digitalization. In January 2023, there were 25.80 million social media users in South Africa, which is 42.9% of the total population and, of course, far behind other BRICS countries. To overcome the digital divide, efforts are being made in South Africa to expand access to technology, promote digital literacy and improve digital skills among the population. As of 2024, South Africa faces high levels of inequality in access to digital technologies. The following aspects of the problem can be highlighted: 1) territorial inequality, a significant part of the population living in rural areas does not have access to the Internet. South Africa has a fairly high level of urbanization (~ 69%), the digital divide between the city and the countryside is still significant; 2) economic inequality, which is confirmed by the high Gini coefficient (63) and affects the availability of digital technologies for the poorest segments of the population; 3) age groups, it should be noted that a significant part of the young population (median age 27.7 years) is better adapted to the digital transition, but structural youth unemployment creates challenges for their involvement in digital projects.

Table 10 presents the results of econometric modeling for **South Africa**, as well as for other countries, models whose equations are statistically significant at a level no higher than 1%.

Table 10: Comparative results of econometric models for South Africa.

Метрика / Факторы	Model number	Adjusted R-squared	S.E. of regression	Sum squared resid	Akaike info criterion	Schwarz criterion	MAPE
X1, X5	Model 1	0,8392	368,0943	2438882	14,786	14,935	2,169
X1, X7	Model 2	0,8731	327,0135	1924881	14,549	14,699	1,822

Model Fit Summary

Comparing the calculation models, we also used standard criteria, allowing comparison of models of similar specification. As can be seen from Table 10, model 2 turned out to be the best, since all the compared criteria, including the MAPE indicator, turned out to be the lowest, thus, this approximation is better compared to other estimated models according to the available data:

$Y = 7637.91 + 54.25 * X1 - 42.31 * X7$,

N=21

- **The adjusted R^2=0.8731** indicates a high correlation between the predictors and GDP per capita even after adjustment and means that approximately 87.31% of the variance of GDP per capita is explained by the predictors.

Statistical significance at a p-value of <0.01 means that the predictor is significant at the 1% level, indicating a high probability that this positive relationship is not due to chance. It can be noted that based on the linear relationship obtained, it can be argued that an increase in the number of **Mobile cellular subscribers** per 100 people in South Africa will increase the average GDP per capita at purchasing power parity by \$54.25 per year, holding other variables constant. While a 1% increase in **Internet users** would reduce per capita GDP at purchasing power parity by \$42.31 per year. This finding is clearly due to the fact that in many regions mobile phones are used primarily for communication rather than for productivity. Without widespread mobile internet use or enhanced mobile services, the economic impact may be limited.

Studying the impact of mobile internet subscriptions rather than general mobile subscriptions may yield a different result, as mobile internet access may directly improve productivity.

The other predictors (not significant)

• **Fixed telephone subscriptions (X3)**, **Exports of ICT goods (X6)**, **Imports of ICT goods (X4)** were not statistically significant predictors (p-values > 0.05). This means that in this model, these variables did not show a strong enough relationship with GDP per capita to be considered reliable predictors of economic stability.

• however, these factors may still have an indirect effect or may be significant in other contexts or with additional data.

The modeling results reveal possible reasons for the insignificance of some factors. For example, the economic impact of ICT exports and imports may depend heavily on a country's production structure. For example, if a country primarily imports ICT goods for consumption rather than for business use, the impact on GDP may be limited. The economic benefits of ICT exports may also be higher in countries that engage in high-value manufacturing, research, or innovation rather than simply assembling or reselling imported components.

Comparative results of the study on BRICS countries

Based on the results of the analysis, a result table was constructed to compare factors that have or do not have a correlation with GDP per capita according to PPP.

Table 11: Summary Table of correlation matrices for BRICS countries.

Country / Variable	Brazil	Russia	India	China	South Africa
X1	+	+	+	+	+
X2	+	+	+	+	+
X3	-	-	+	+	-
X4	-	+	-	-	+
X5	-	+	-	+	-
X6	+	-	-	-	-
X7	+	+	+	+	-

«+» a correlation was identified (p value > 70%)

«-» no correlation identified

As can be seen from the table, the predictors **Mobile Cellular Subscriptions** и **Fixed Broadband Subscriptions** have a positive correlation with GDP in all BRICS countries. The predictor **Internet users** also has a positive correlation with GDP in all countries except South Africa. The correlation of other factors with GDP varies from country to country, highlighting the uneven level of digitalization development in the BRICS countries.

Table 12: Summary Table of correlation matrices for BRICS countries.

Country	**Estimated model**
Russia	$Y = 22444.52 + 58.46 * X1 + 63.86 * X7$
China	$Y = 3433.21 + 77.81 * X1 + 186.21 * X2$
India	$Y = 2418.49 + 24.94 * X1 + 76.27 * X7$
Brazil	$Y = 15120{,}98 + 39{,}36 * X1 - 147{,}64 * X4$
South Africa	$Y = 7637{,}91 + 54{,}25 * X1 - 42{,}31 * X7$

Analysis of the resulting models suggests that:

Mobile Cellular Subscriptions (X1) and Fixed Broadband Subscriptions (X2)

• in many countries mobile phone penetration is already very high, leading to diminishing marginal returns in terms of economic impact.

• in many countries mobile phones are primarily used for communication rather than for productivity. Without widespread use of mobile internet or advanced mobile services, economic impact may be limited.

Studying the impact of mobile internet subscriptions specifically, rather than general mobile subscriptions, may yield different results, as mobile internet access may directly improve productivity.

• Fixed broadband subscriptions (X2) have a significant positive relationship with GDP per capita, suggesting that expanding broadband access contributes to economic growth. This positive relationship is consistent with the idea that broadband access contributes to economic productivity. Expanding broadband connectivity likely improves the flow of information, enables e-commerce, facilitates remote working, and supports the development of digital skills, all of which are valuable for economic stability and growth. For policymakers, this finding suggests that investment in broadband infrastructure may be a key driver of economic development.

Fixed Telephone Subscriptions (X3)

• the growth of mobile and Internet communications has made fixed telephones less relevant to economic growth. Fixed-line telephone lines are expensive to maintain, and the resources devoted to this infrastructure may not contribute as much to GDP as investments in digital infrastructure.

ICT Goods Exports (X6) and ICT Goods Imports (X4)

• the economic impact of ICT goods exports and imports has been identified for individual BRICS countries. This may depend on the country's production structure. For example, if a country primarily imports ICT goods for consumption rather than for business use, the impact on GDP may be limited.

• the economic benefits of ICT goods exports may also be higher in countries that engage in high-value manufacturing, research, or innovation rather than simply assembling or reselling imported components.

ICT Services Exports (X5)

• this factor was not significant in any model or in any BRICS country, although there are countries, such as India, China, and Russia, that export ICT services. The negative association here may seem counterintuitive, but it may suggest certain economic dependencies or vulnerabilities associated with ICT service exports. It may be that economies that rely heavily on ICT service exports may be vulnerable to fluctuations in global demand, which affects domestic economic stability. It may also suggest that if the benefits of ICT service exports are not widely distributed across the economy, the broader population may not receive significant economic benefits. If a country is a major exporter of ICT services but relies on cheaper labor or infrastructure investment abroad, the economic benefits may be limited within the country.

Internet Users (X7)

• The economic benefits of using the Internet depend directly on a number of factors, including connection quality, access speed, and the ability to obtain the necessary data.

• Using the Internet does not guarantee economic growth. The most important factors here are digital literacy and the ability of the population to effectively use the Internet for productive purposes.

5 CONCLUSION

The results of the analysis show that addressing the digital divide requires a comprehensive approach. The analysis recommends the following: Increase investment in broadband, given the positive impact of fixed broadband on GDP per capita, which can improve economic stability and growth, especially in underserved areas. Explore ways to make ICT services exports more resilient to fluctuations in global demand or ensure that the benefits of these exports are widely shared. Further analysis is needed on the non-significant predictors in some BRICS countries, for example mobile cellular subscriptions or internet user tariffs may have different effects when studied at a more detailed level or with a focus on specific sectors. Investments in mobile infrastructure can also contribute to greater Internet penetration. In addition, digital literacy education programs can help people make the most of the Internet for economic activities. Motivational instruments are also needed to increase the import of ICT goods, which in turn promotes technological development and can support local technological infrastructure. There is a need to expand training programs to upskill in high-demand ICT areas and provide support to start-ups and small businesses offering ICT services. An important area for creating new economic opportunities is to stimulate the export of high-value or innovative ICT goods. The implementation of the proposed recommendations can help to bridge the digital divide and use information and communication technology (ICT) infrastructure to promote economic stability and growth.

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