SCIENCE AND INNOVATION INVESTMENTS IN GLOBAL NORTH-SOUTH CONTEXT

INVESTIMENTOS EM CIÊNCIA E INOVAÇÃO NO CONTEXTO NORTE-SUL GLOBAL

INVERSIONES EN CIENCIA E INNOVACIÓN EN EL CONTEXTO GLOBAL NORTE-SUR

Cited as:
Saisse, Rosangela L. G., Gomes, Josir S. & Bouzada, Marco A. (2024). Science and innovation investments in Global North-South context. Revista Gestão & Tecnologia. Journal of Management and Technology. v 24, nº 1. p .149-166

Rosangela de Lima Gonçalves Saisse
Doutoranda do Programa de pós Graduação em Administração da UNIGRANRIO
http://orcid.org/0000-0001-6365-1730

Josir Simeone Gomes
Professor do Programa de Pós-Graduação em Administração (PPGA/UNIGRANRIO).
https://orcid.org/0000-0002-2721-1786

Marco Aurélio Carino Bouzada
Professor do Programa de Pós-Graduação em Administração (PPGA/UNIGRANRIO).
https://orcid.org/0000-0002-7183-1325

Scientific Editor: José Edson Lara
Organization Scientific Committee
Double Blind Review by SEER/OJS
Received on 30/06/2023
Approved on 06/03/2024

ABSTRACT

Objective: This study aims to present an analysis in relation to the debate on the role of gross domestic investments in Research and Development (R&D) as a fundamental variable in the capacity of technology absorption by national innovation systems and the economic performance of two geoeconomic groups of countries in the face of global competitiveness.
Methodology: The methodology used was based on the analysis of the socioeconomic peculiarities existing among 16 nations of the referred blocks, in the period of ten years (2011 to 2020), from data obtained from the reports of the Global Innovation Index and the WIPO. For the modeling, an electronic spreadsheet was used for structuring and verifying the data.
Originality/Relevance: Factors such as infrastructure, international trade and human capital influence developing countries on their way to a place in various sectors of the world economy and the elaboration of public policies in S&T, on the part of decision makers, plays an important role in improving these factors.
Main results: The analysis of the results highlights the existence of a structural gap that persists over the years between nations both in terms of R&D and with regard to national innovation systems and that investments in R&D are fundamental for the development and consolidation of scientific advances that will result in better performance in global indicators.
Theoretical/methodological contributions: Despite the need for a greater expansion of research, both in number of economies and periods to be achieved, we believe that this study brought a perception of the performance of countries in relation to their investments in scientific research and its importance for the growth of nations.

Keywords: Gross domestic expenditure on R&D; GERD; Global Innovation Index; North-South Context; Science.

RESUMO

Objetivo: Este estudo objetiva apresentar uma análise em relação ao debate sobre o papel dos investimentos interno bruto em Pesquisa e Desenvolvimento (P&D) como uma variável fundamental na capacitação de absorção de tecnologias pelos sistemas nacionais de inovação e a atuação econômica de dois grupamentos geoeconômicos de países frente à competitividade global.
Metodologia: A metodologia utilizada partiu da análise das peculiaridades socioeconômicas existentes entre 16 nações dos referidos blocos, no período de dez anos (2011 a 2020), a partir de dados obtidos dos relatórios do Índice Global de Inovação e da WIPO. Para a modelagem, foi utilizada uma planilha eletrônica para estruturação e verificação dos dados.
Originalidade/Relevância: Fatores como infraestrutura, comércio internacional e capital humano influenciam os países em desenvolvimento em seu caminho para ocupar um lugar em diversos setores da economia mundial e a elaboração de políticas públicas em C&T, por parte dos tomadores de decisão, tem papel importante no sentido de melhorar tais fatores.
Principais resultados: A análise dos resultados destaca a existência um gap estrutural que persiste ao longo dos anos entre as nações tanto em termos de P&D como no que se refere aos sistemas nacionais de inovação e que os investimentos em P&D são fundamentais para o

desenvolvimento e consolidação de avanços científicos que resultarão em melhor desempenho em indicadores globais.
Contribuições teóricas/metodológicas: Apesar da necessidade de uma maior ampliação das pesquisas, tanto em número de econômias quanto de períodos a serem alcançados, acreditamos que este estudo trouxe uma percepção do desempenho dos países em relação aos seus investimentos em pesquisa científica e sua importância para o crescimento das nações.

Palavras-Chave: Investimentos Interno Bruto em Pesquisa e Desenvolvimento. P&D. Índice Global de Inovação. Norte-Sul Global, Ciência

RESUMEN
Objetivo: Este estudio tiene como objetivo presentar un análisis en relación con el debate sobre el papel de las inversiones internas brutas en Investigación y Desarrollo (I&D) como variable fundamental en la capacidad de absorción de tecnología por los sistemas nacionales de innovación y el desempeño económico de dos grupos geoeconómicos de países frente a la competitividad global.
Metodología: La metodología utilizada se basó en el análisis de las peculiaridades socioeconómicas existentes entre 16 naciones de los bloques referidos, en el período de diez años (2011 a 2020), a partir de datos obtenidos de los informes del Índice Mundial de Innovación y de la OMPI. Para el modelado, se utilizó una hoja de cálculo electrónica para estructurar y verificar los datos.
Originalidad/Relevancia: Factores como la infraestructura, el comercio internacional y el capital humano influyen en los países en desarrollo en su camino hacia un lugar en diversos sectores de la economía mundial y la elaboración de políticas públicas en C&T, por parte de los tomadores de decisiones, juega un papel importante en la mejora de estos factores.
Resultados principales: El análisis de los resultados pone de manifiesto la existencia de una brecha estructural que persiste a lo largo de los años entre las naciones, tanto en términos de I&D como con respecto a los sistemas nacionales de innovación y que las inversiones en I&D son fundamentales para el desarrollo y consolidación de avances científicos que redundarán en un mejor desempeño en los indicadores globales.
Aportes teóricos/metodológicos: A pesar de la necesidad de una mayor expansión de la investigación, tanto en número de economías como en períodos a alcanzar, creemos que este estudio trajo una percepción del desempeño de los países en relación con sus inversions en investigación científica y su importancia para el crecimiento de las naciones.

Palabras-clave: Inversiones internas brutas en investigación y desarrollo. I&D. Índice Global de Innovación. Global Norte-Sur, Ciencia

1. INTRODUCTION

In the competitive scenario, it is extremely important to have an adequate evaluation of the national performance face to the constant changes in the global market, generated by the economic growth that, in turn, is promoted by technological innovation.

Despite the non-acceptance of a definition of the term, in general, there is an agreed consensus that innovation is usually defined as the conversion of knowledge into new technologies, products and commercialized processes and how they are brought to the market. (INSEAD, 2011)

In Castellacci and Natera (2013), innovation is stimulated by the evolution of the system's innovative capacity and the capability to absorb innovation, treating in the latter with factors such as infrastructure, international trade and human capital.

In this sense, concerning to the human capital factor, investments in Research and Development (R&D) are essential, aiming at fostering innovation, generating positive national and transnational impacts, which play an important role in the ability to absorb knowledge, for development technological.

According to Cerqueira (2016), between human capital and innovative capacity there is a positive relationship that will bring greater competitiveness in the international market.

Highlight the fact that the generation of innovation and its benefits are no longer only seen in high-income countries. Innovative activity disseminates significantly among countries considered in development. However, persist still a large gap in the ambit of level of income, per capita GDP growth rate and economic growth due to technological distance, because of the performance of innovation between countries in the global economy.

At the global level, the development of competitive value and the consequent permanence in the market are based on the ability to develop the human capital and innovation that generate the productivity growth necessary to satisfy the growing demand for new technologies. National policies for the acquisition, adaptation, imitation and improvement of new technologies are fundamental, as well as necessary structural, internal, adequate conditions for the adoption of innovation coming from countries and markets with higher levels of development.

In accordance with the World Intellectual Property Report (2011), the change in the global scenario of innovation is due to several and concomitant factors, such as a greater share of GDP being invested in knowledge, scientific research being carried out by interconnected collaborators, the increase in the workforce focused on Science and Technology (S&T), all of this also generating a greater flow of open innovation between economies.

In this context, the present work, supported by primary data available in the annual reports of the Global Innovation Index (GII), presents the role of investments in R&D, as a fundamental variable in the absorption capacity of the national innovation system of the nation for the performance of countries globally. From this report, data referring to eight emerging countries of the Global South and eight major powers of the Global North were taken for analysis in relation to the debate on the economic performance of these countries in face of global competitiveness.

2. LITERATURE REVIEW

R&D expenditures

Measure the innovative capacity of a nation means looking at variables such as, request for intellectual protection, publication in scientific journals, well-developed education system, promotion of Research and Development in Science and Technology, not being, therefore, a simple calculation because these factors should be combined with others such as public policies linked to the fomentation of innovation and the growth of a creativity ecosystem.

For this study, the investment in R&D factor was chosen to create a comparison between the positioning of countries of the Global North and South.

R&D financing has been considered a high-impact vector for economic growth and global competitiveness by means of accelerating innovation, capital accumulation and human capital development. Consolidating the contribution to R&D, understood as a fundamental role for the dissemination and strengthening of innovation with the consequent economic development. This being the posture adopted by economies intensive in R&D and innovation (Bor et al., 2010).

Coelho and De Negri (2011) infer that “Direct government financing allows public subsidies to be directed towards activities that offer the highest social returns on research spending [...]”.

Since Human Capital is an important sector to consider, for creating the country's capacity to absorb technological advances as much as, depending on its capacity, to create new technologies. Indicating Griffith (2004), the importance of the level of knowledge of human

capital to enhance the technological absorption ability and the relative return to new technologies.

The main aspects of the technology and knowledge deficits in many developing countries are easily discerned by looking at indicators such as, for example, the portion of gross domestic product (GDP) devoted to scientific and technological research.

Global Innovation Index

As specified by the website significados.com, an index "[...] can be the same as an indicator, symptom or sign, a reference factor that serves as a comparator to explain a given situation or condition".

The Global Innovation Index is about an assessment and comparison of the performance of national innovation systems across world economies, compiled on an annual basis, which seeks to constantly update and improve the way innovation is measured.

The GII is made available by the World Intellectual Property Organization (WIPO), an international entity that is member of the United Nations System, headquartered in Switzerland, created in 1967 to promote and protect intellectual property around the world. Beyond the The Global Innovation Index, it presents the World IP Indicators report and the World IP Report. Developed by WIPO since 2011, the GII classifies countries within 7 pillars, of which 5 pillars compose the input sub-index that deals with Inputs for innovation and 2 pillars make up the output sub-index that deals with innovation Production. Each pillar is divided into three sub-pillars and each sub-pillar is made up of individual indicators, totaling 81 indicators (Table 1). Of the 81 indicators, 65 variables are hard data, 13 are composite indicators, and three are questions from the World Economic Forum Executive Opinion Survey (GII, 2022).

The overall Innovation Index score is a simple average of the scores on the Innovation Inputs and Innovation Outputs Sub-Indices. The GII includes in its assessments 132 economies, selected based on data availability, representing 94.1% of the world's population and 98.5% of global GDP (in current US dollars) (GII, 2022).

Indicator data is collected from international bodies such as the World Intellectual Property Organization (WIPO), the International Energy Agency, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the United Nations Industrial

Development Organization (UNIDO), the International Telecommunication Union (ITU) and the Joint Research Center (JRC) of the European Commission, as well as private organizations such as the International Organization for Standardization (EU), IHS Global Insight, Quacquarelli Symonds Ltd, Bureau van Dijk (BvD), Yale University, ZookNIC Inc, PricewaterhouseCoopers and others to obtain the best available data on measuring innovation globally (GII, 2022)

Table 1
Framework of the Global Innovation Index

	PILLAR 1 Institutions	
Political environment	**Regulatory environment**	**Business environment**
Political and operational stability	Regulatory Quality	Policies for doing business
Government effectiveness	Rule of law	Entrepreneurship policies and culture
	Excessive layoff costs	
PILLAR 2 Human capital and research		
Education	**Tertiary education**	**Research and development (R&D)**
Expenditure on education, % GDP	Tertiary enrolment, % gross	Researchers, FTE/mn pop
Government funding/pupil, secondary, % GDP/cap	Graduates in science and engineering, %	Gross expenditure on R&D, % GDP
School life expectancy, years	Tertiary inbound mobility, %	Global corporate R&D investors,
PISA scales in reading, math and science		QS university ranking, top 3
Pupil–teacher ratio, secondary		
	PILLAR 3 Infrastructure	
Information and communication technologies	**General infrastructure**	**Ecological sustainability**
ICT access	Electricity output	GDP/unit of energy use
ICT use index	Logistics performance	Environmental performance
Government's online service	Gross capital formation	ISO 14001 environmental certificates
E-participation		
	PILLAR 4 Market sophistication	
Credit	**Investment**	**Trade, diversification, and market scale**
Finance for startups and scaleups	Market capitalization	Applied tariff rate, weighted avg
Domestic credit to private sector	Venture capital investors	Domestic industry diversification
Loans from microfinance institutions	Venture capital recipients	Domestic market scale,
	Venture capital received	
	PILLAR 5 Business sophistication	
Knowledge workers	**Innovation linkages**	**Knowledge absorption**
Knowledge-intensive employment	University–industry R&D collaboration	Intellectual property payments,
Firms offering formal training	State of cluster development and depth	High-tech imports
GERD performed by business	GERD financed by abroad,	ICT services imports
GERD financed by business	Joint venture/strategic alliance deals	FDI net inflows
Females employed w/advanced degrees	Patent families/bn	Research talent
PILLAR 6 Knowledge and Tecnology outputs		
Knowledge creation	**Knowledge impact**	**Knowledge diffusion**
Patents by origin	Labor productivity growth	Intellectual property receipts
PCT patents by origin	New businesses/th pop	Production and export complexity
Utility models by origin	Software spending	High-tech exports
Scientific and technical articles	ISO 9001 quality certificates	ICT services exports

Citable documents H-index	High-tech manufacturing	
	PILLAR 7 Creative outputs	
Intangible assets	**Creative goods and services**	**Online creativity**
Intangible asset intensity,	Cultural and creative services exports	Generic top-level domains
Trademarks by origin	National feature films/mn pop. 15-69	Country-code TLDs/th pop. 15-69
Global brand value	Entertainment and media market	GitHub commit pushes received
Industrial designs by origin	Printing and other media	Mobile app creation
	Creative goods exports	

Note. Source*:* Authors' elaboration using data from World Intellectual Property Organization, 2022

The GII was adopted based on studies that indicate the index as a rich set of data for comparative analysis of innovation between organizations and nations, characterizing the conditions for the development of innovative investments (Jankowska et al. (2017); Davydova et al. (2016); Prim et al. (2017); Crespo & Crespo (2016); Nair et al. (2014)).

North-South Asymmetry

A division for the world geographic space can be made by delimiting the international system into two groupings, observing not its spatial location, but considering the issue of its economic development indicators. In that sense, a divisional partition is created where a rich "Global North" is differentiated from an impoverished "Global South" (Lewis, 2010), suggesting the ideation of a North-South segmentation, which does not correspond, in life reality, to the complex and unequal developments observed in the world (Kaltmeier, 2015).

The terms global North and South were disseminated through a report created by former German Chancellor Willy Brandt, in the early 1980s, where a North/South line was conceptualized also known as Brandt Line. Rigg (2015) shows that "The South is a geographic convenience based on the fact that most of the Poor World lies south of latitude 30° North.".

The Report, by pointing out the "[...] need for greater investments in the austral regions of the Planet, in order to contour the imminent economic and environmental crises [...]" (Fonseca, 2016), based the creation of the term South Global.

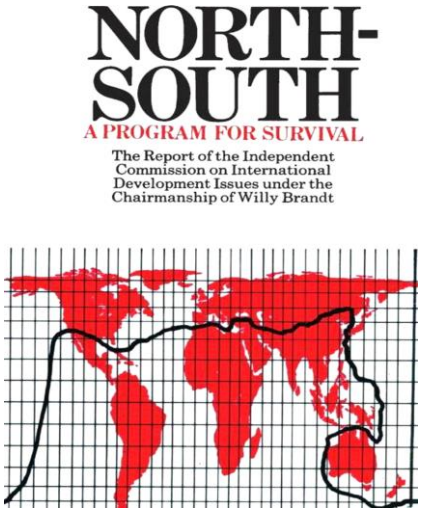

Figure 1. Cover of the 1980 issue of the Report: North-South: A survival program

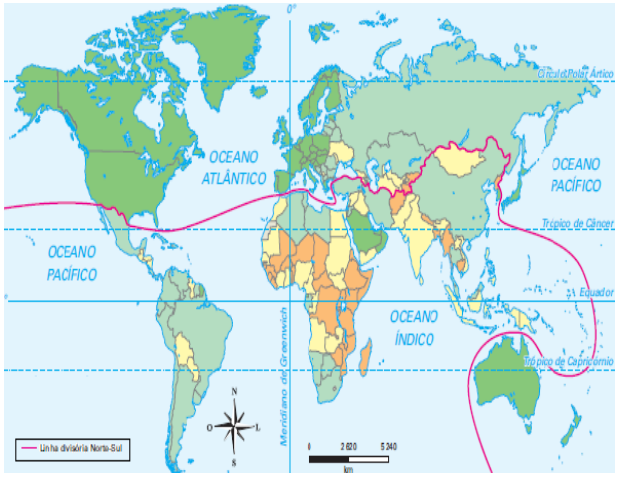

Figure 2 North - South Division representative map
Source: Geografia: o mundo em transição (2013)

At the economic limits of the South are the regions from Latin America to Mexico in the North; the Caribbean; the Middle East (except Israel); North and Sub-Saharan Africa; South and Southeast Asia as well as the Pacific; Turkey and part of Central Asia; former Soviet republics that form Central and Eastern Europe and the EU countries Bulgaria and Romania.

Already in the North economic limits, there is a group of countries identified by the World Bank, as having a high level of income, whose GDP/inhabitant is superior to 12,375 $US annually, grouping, thus, countries belonging to the European Union, including some States of the Central and Eastern Europe, the United States of America, Canada, Japan, South Korea, in the Pacific Australia and New Zealand and about 40 other countries located in different latitudes (CADTM, 2020).

3. METHODOLOGY

The methodology used to present the existing chasm, about public investments in R&D, between the blocs denominated Global North and Global South started from the analysis of socioeconomic peculiarities existing between nations of referred blocs.

Seeking to elucidate this issue, a mapping of the trajectory of countries in their investments in R&D was carried out, in the period of ten years (2011 to 2020). For selection purposes, sixteen countries were chosen, eight from each group. From Global North, we selected USA, Canada, UK, Singapore, Republic of Korea, Israel, Finland and Japan. As well as, from the Global South, we selected South Africa, Brazil, Mexico, Egypt, India, Iran, Philippines, Russian Federation. Stands out that the choice of these countries aimed to present an image of the global geographic regions segmented according to the Statistics Division of the United Nations depicted in Table 2. To create a frontier panorama, we brought China and presented it separately, because despite being inserted in the southern block shows great competitive potential in the global context.

Table 2
Sample composition

	Country	Region		Country	Region
Global South	Brazil	South America	Global North	Canada	Northern America
	China	Eastern Asia		Finland	Northern Europe
	Egypt	Northern Africa		Israel	Western Asia
	India	Southern Asia		Japan	Eastern Asia
	Iran	Southern Asia		Republic of Korea	Eastern Asia
	Mexico	Central America		Singapore	South-eastern Asia
	Philippines	South-eastern Asia		United Kingdom	Northern Europe
	Russian Federation	Eastern Europe		United States of America	Northern America

It's a research with a quantitative approach, of a nature classified as applied because it raises a problem and generates, according to Silva and Menezes (2005), "[...] knowledge for practical application and directed to the solution of specific problems." and as for the objective, adjust as descriptive in nature by describing individuals, groups, activities, events or situations of social life (Leavy, 2017), and explanatory by bringing correlations between variables bringing the causes and effects.

We built our sample set from two available databases, for the selected countries: the annual reports of WIPO and UNESCO. Our sample value is formed by 160 observations, derived from the fact that 16 countries were observed over 10 years.

For modeling, in relation to investments in R&D and elements taken from the Global Innovation Index, an electronic spreadsheet was used for structuring and verification of data.

4. RESULTS AND ANALYSIS

The exploratory analysis, after mapping, is presented with graphs and basic tables. The ordering and construction of the trajectory of the countries (Figure 3), in the period from 2011 to 2020, allows visualize the positioning of the countries, in the criterion Gross Investment in R&D, during the period.

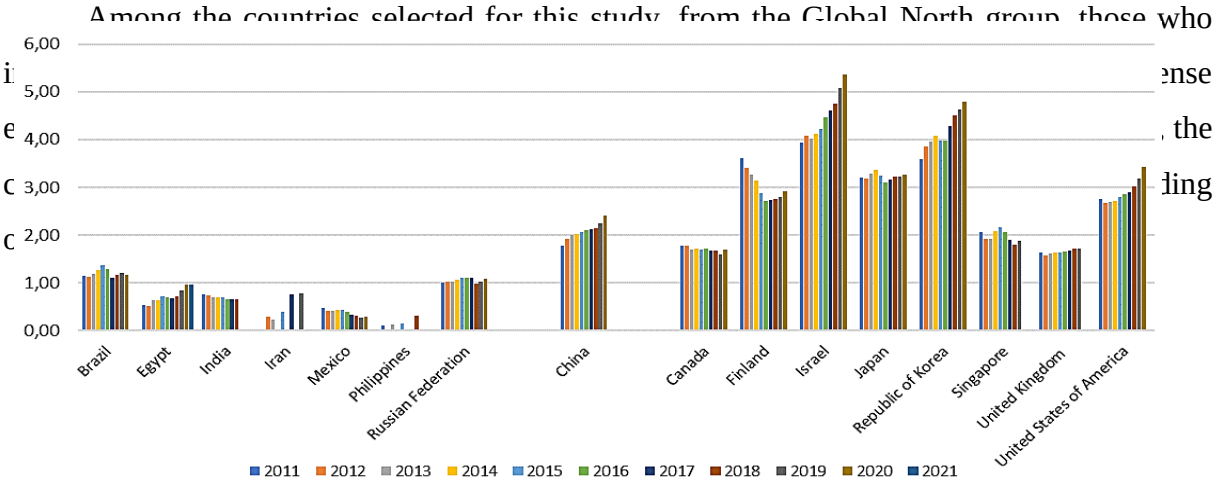

Figure 3. Trajectory of R&D expenditures (% of GPD)
Source: Authors' elaboration using data from UNESCO's Institute for Statistics, 2011/2020

In this period and with the referred data, two considerations stand out. First, the fact that there is still an "abyss" between developed and developing countries - see Figure 3 - being this analysis corroborated by Castellacci and Natera (2013), in the fact that less developed countries distance themselves from the more developed ones because they have in their national innovation systems lack of key factors such as investment in human capital, infrastructure and technical training that enable the absorption of knowledge and consequent scientific growth.

Thus, at the time, the report Transfer of technology and knowledge sharing for development (United Nations Conference on Trade and Development – UNCTAD, 2014) also pointed out the panorama in 2002, 2007 and 2009 for developed and developing countries in this same criterion, see Figure 4.

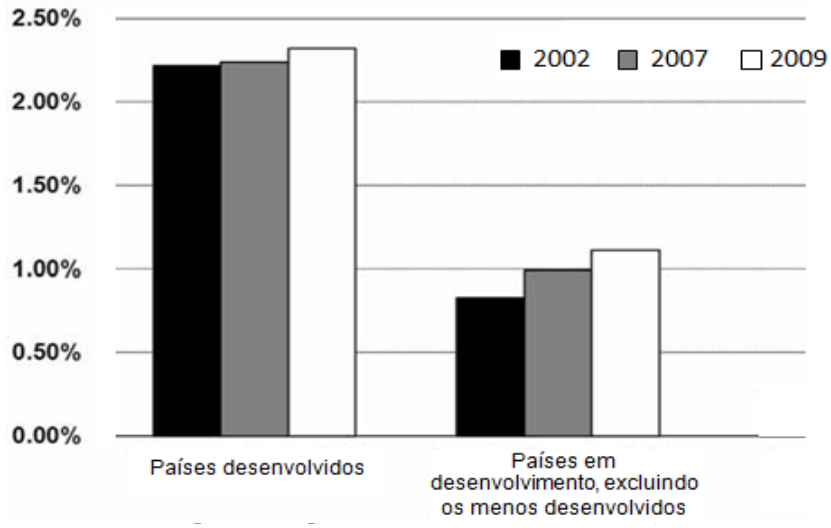

Figure 4. Rese

Source: United Nations Conference on Trade and Development, 2014

The second consideration lies in the fact that, although the developed economies remain better positioned in this criterion, there are economies that integrate the Southern bloc that, in the long term, are reaching considerable levels in R&D. The data show that new actors are arriving to alter the Global North/South scenario, as is the case of China, which despite being theoretically inserted in the Global South group, in view of issues such as infrastructure and average income, its performance is more aligned with the Global North for showing itself an innovation-oriented country due to its successful policies for innovation, science and technology in the context of structuring the economy and integration into the global economy (Szapiro, 2017).

China as a great Asian power, in the global context, is the result of the efforts of public policy makers to build an R&D and innovation agenda that came to strengthen and enhance its national innovation system. As exposed in the Transfer of technology and knowledge sharing for development (UNCTAD, 2014), “Building national systems of innovation that enable both domestic innovative capabilities and absorptive capacity to effectively acquire technology from abroad is a long-term, complex effort that calls for policy persistence, coordination and integration.".

We can affirm that scientific discoveries are the result of investments in research and that these explain the fact that more than 46% of all patent applications in 2021, in the world, occurred in the intellectual property offices of China (https://www.wipo.int/en/ipfactsandfigures/patents). As well as explain the intensity of China's output in scientific production, in line with the advances arising from the investments in R&D, culminating, progressively, in the promotion of scientific cooperation between scholars from other nations that come, especially, to foment public policies in S&T. Backer et al (2005) and Tsui-Auch (2003) explore this perspective of scientific cooperation, stating that sharing in such relationships is beneficial and creates new forms of understanding, learning and innovation, meeting the many dimensions of knowledge along the way of time.

In view of the exposed, Amaral et al. (2017), identifies that scientific production indicators have contributed, as an analysis tool, to reveal aspects of economic and social development in economies.

Considering this point of view, we present a metric (Figure 5) on the topic with the evolution of scientific publications from the sixteen countries in the sample, based on reports of the SCImago Journal & Country Rank that monitors several countries in their scientific productions from the database Scopus® (Elsevier BV), considered of high relevance in academi

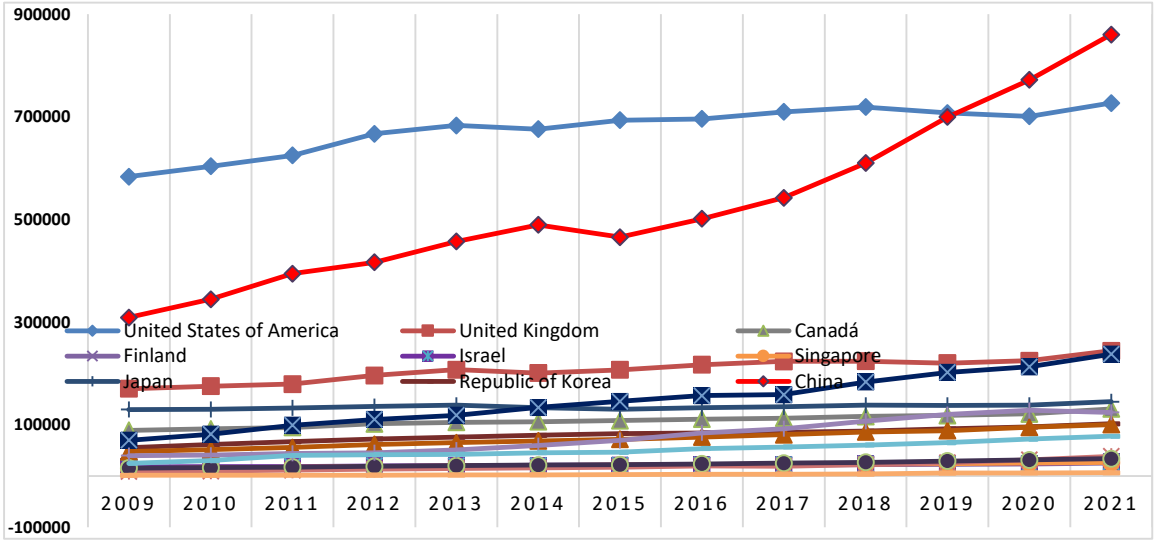

Figure 5. Scientific Production
Source: Authors' elaboration using data from SCImago Journal & Country

In sequence, we present in Figure 6, by way of comparison, a record of the scores in the Global Innovation Index of the selected countries in the period from 2011 to 2022. With emphasis on China, where its rapid growth achieved in Innovation, contrast in the graphic. Putting that country in a position to go against protectionist and unilateral measures by more developed countries.

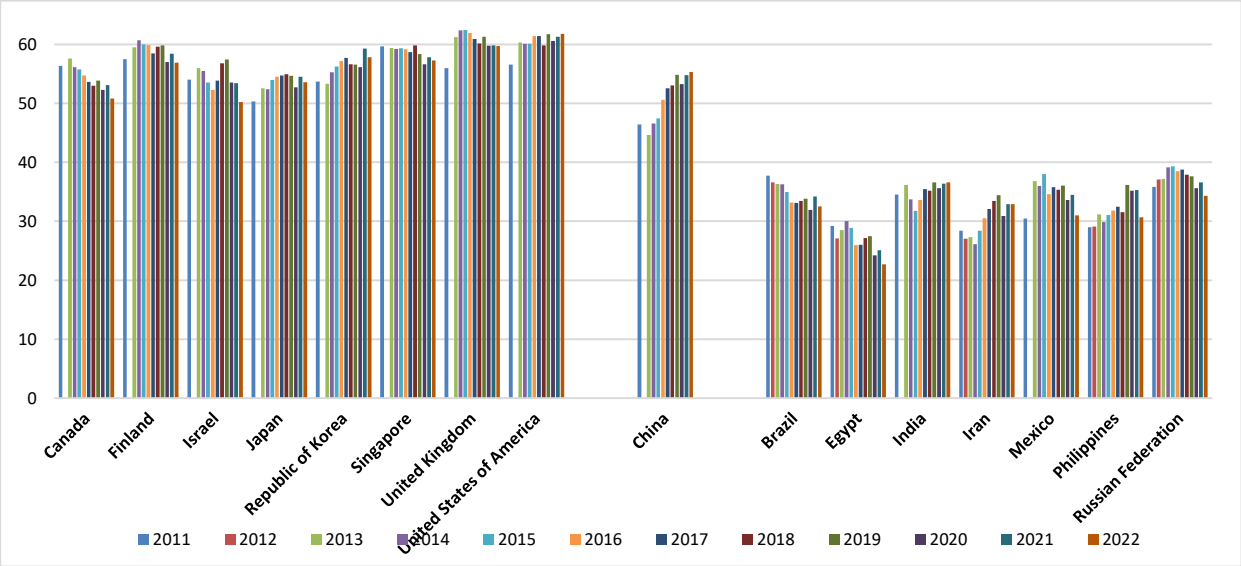

Figure 6. Country scores on the GII
Source: Authors' elaboration using data from GII 2011/ 2022

In this sample group, the USA and the UK lead, registering the best performances in the number of IGI indicators. Stand out that in the world, according to the Global Innovation Index 2022, the USA has the best score in terms of global business investors in R&D, venture capital investors, quality of universities, quality and impact of scientific publications (H index), number of patents by origin, software spending and intensity of corporate intangible assets.

But, always rising, China is advancing in its positions, being among the 15 most innovative economies in the world in the 2022 GII report and tending to continue its rise towards the top ten economies, seen to have achieved the 11th position in 2022 in the ranking. Differently, in a relatively modest way, the other economies of the group are presenting themselves.

5. CONCLUSIONS

With the development of this study, it could be noticed that factors such as infrastructure, international trade and human capital that influence developing countries on their way to take a seat in various sectors of the world economy. Regarding the human capital factor, investments in Research and Development (R&D) are fundamental for the development and consolidation of scientific advances that will result in better performance in global indicators.

The fact that Mexico shares a border with a developed country like the US has not, historically speaking, guaranteed national elements that visualized ways to guarantee similar growth. Still within this context, we can mention India, neighboring China, with its past as a former British colony, where despite its scientific and industrial growth, it suffers from serious issues of unity and populational infrastructure.

The policy of high investment in R&D in Israel speaks of a nation established in the midst of conflicts with several neighboring nations, both from a democratic political point of view and from the point of view of this country's religious option. This belligerence leads to strong research in science and technology (S&T) in auto defense´s area, which necessarily comes to be experimented by themselves and exported, thus bringing good results in terms of world competitiveness.

As can be seen, investments in R&D and the improvement of internal innovation systems as potentiating channels of the national economy. Thus, regarding to reducing this technological gap, it is understood that the elaboration of public policies in S&T, by decision makers, have an important role in the sense of improving such factors, aiming at the promotion and strengthening of the ecosystem of innovation.

Among the economies of the Global South, China shows itself with an intense investment in R&D, as well as maintaining the leadership in the classification of the Global Innovation Index 2022.

We conclude by pointing to the emergence of a new geographic segmentation of world, different from North-South, as already shown in its first edition, in 2019, the Digital Economy Report, that: “[…] the world is characterized by a yawning gap between the under-connected and the hyper-digitalized countries.” (UNCTAD, 2019). We draw attention here too to the fact that the Corona Virus pandemic crisis, with the consequent search for containment of the

disease, increased the level and volume of scientific research, accelerating this geographical shift of innovation towards Asia. With great performances in innovation, besides China, we have the Republic of Korea, Singapore and Hong Kong.

As a limitation of research, we accuse the use of IGI indicators in the context of sixteen selected countries, in a period of ten years. Therefore, for future research, we recommend extending the period and incorporating other economies in the sample. Despite the need for further research, we believe that this study has brought a perception of the performance of countries regarding their investments around scientific research.

REFERENCES

Amaral, R. M., Quoniam, L., Faria, L. I. L., Leiva, D. R., Milanez D. H., & Fioroni, J. (2017). Ultrapassando as barreiras de conversão e tratamento de dados: indicadores de produção científica dos programas de pós-graduação em engenharia de materiais e metalúrgica. *Em Questão, 23*(1), 228-253. https://doi.org/10.19132/1808-245231.228-253

Baker, A. C., Jensen, P. J., & Kolb, D. A. (2005). Conversation as Experiential Learning. *Management Learning, v. 36*(4), 411–427. https://doi.org/10.1177/1350507605058130

Bor, Y. J., Chuang, Y., Lai, W., & Yang, C. (2010). A dynamic general equilibrium model for public R&D investment in Taiwan. *Economic Modelling, 27*, 171-183. https://doi.org/10.1016/j.econmod.2009.08.007

Castellacci, F., & Natera, J. M. (2013). The dynamics of national innovation systems: A panel cointegration analysis of the coevolution between innovative capability and absorptive capacity. *Research Policy, 42(3),* 579-594. https://doi.org/10.1016/j.respol.2012.10.006.

Cerqueira, H. M. A. (2016) *Capital humano, inovação e competitividade nos mercados internacionais*. [Master's dissertation] University of Minho, Portugal. http://repositorium.sdum.uminho.pt/handle/1822/42905.

Coelho, D. S. C., & De Negri, J. A. A. (2011, December). Impacto do financiamento do BNDES sobre a produtividade das empresas: Uma aplicação do efeito quantílico de tratamento**.** *Proceedings of the 38th Brazilian Economics Meeting,* 119, Salvador, Bahia, Brazil. Brazilian Association of Graduate Programs in Economics. https://ideas.repec.org/p/anp/en2010/119.html.

Comité pour l'abolition des dettes illégitimes – CADTM. (2020). ***Sul/Norte, países em desenvolvimento/países desenvolvidos: que significa tudo isso?*** http://www.cadtm.org/Sul-Norte-paises-em-desenvolvimento-paises-desenvolvidos-que-significa-tudo**.**

Crespo, N. F., & Crespo, C. F. (2016). Global innovation index: Moving beyond the absolute value of ranking with a fuzzy-set analysis. *Journal of Business Research, v. 69*(11), 5265–5271. https://www.sciencedirect.com/science/article/abs/pii/S0148296316303277

Cornell University, INSEAD & WIPO. (2020). ***The Global Innovation Index 2020: Who Will Finance Innovation?*** https://www.wipo.int/edocs/pubdocs/pt/wipo_pub_gii_2020.pdf

Davydova, A., Ibatullina, A., & Pachkova, O. (2016). *Estimation of innovative-investment development of the countries of the brics group.* Kazan Federal University.

https://dspace.kpfu.ru/xmlui/handle/net/143820

Fonseca, L. R. B. (2016). *O Sul Global e o desenvolvimento do conceito da responsabilidade de proteger: CIBAS* e o caso líbio. [Conclusion of Course Work, Graduation]. Federal University of Paraiba, João Pessoa, Paraíba, Brazil. https://repositorio.ufpb.br/jspui/bitstream/123456789/1664/1/LRBF19072017.pdf

Griffith, R., Redding, S., & Reenen, J. V. (2004). Mapping the Two Faces of R&D: Productivity Growth in a Panel of OECD Industries. *Review of Economics and Statistics, 86(4)*, 883-895. http://doi.org/10.1162/0034653043125194

INDICE. In:Significados. 7Graus, © 2011 – 2023. https://www.significados.com.br/indice.

Institut Européen d'Administration des Affaires - INSEAD. (2011). *The Global Innovation Index 2011 - Accelerating Growth and Development.* https://www.globalinnovationindex.org/userfiles/file/GII-2011_Report.pdf

Jankowska, B., Matysek-Jędrych, A., & Mroczek-Dąbrowska, K. (2017). Efficiency of National Innovation Systems – Poland and Bulgaria in The Context of the Global Innovation Index. *Comparative Economic Research, v. 20*(3). DOI: 10.1515/cer-2017-0021

Kaltmeier, O. (2015). Global South. In: A. Hollington, T. Salverda, T. Schwarz & O. Tappe (Eds.) *Concepts of the Global South*. Global South Studies Center. https://kups.ub.uni-koeln.de/6399/1/voices012015_concepts_of_the_global_south.pdf

Leavy, P. (2017). *Research Design: Quantitative, Qualitative, Mixed Methods, Arts-Based, and Community-Based Participatory Research Approaches.* The Guilford Press.

Lewis, M. W. (2010). *There is no Third World; There is no Global South*. GeoCurrents, http://www.geocurrents.info/economic-geography/there-is-no-third-world-there-is-no-global-south.

Nair, H., Kumar, A., & Ahmed, O. (2014). Neural network modelling, simulation and prediction of innovation growth in United Arab Emirates (UAE). *Procedia Computer Science*, *36*, 269-275. https://www.sciencedirect.com/science/article/pii/S1877050914013416

Prim, A. L., Filho, L. S., Zamur, G. A. C., & Di Serio, L. C. (2017). The relationship between national culture dimensions and degree of innovation. International Journal of Innovation Management, 21(1), 1730001. https://doi.org/10.1142/S136391961730001X doi: https://doi.org/ 10.1142/S136391961730001X

Rigg, J. (2015). The Global South. In: A. Hollington, T. Salverda, T. Schwarz & O. Tappe (Eds.) *Concepts of the Global South*. Global South Studies Center. https://kups.ub.uni-koeln.de/6399/1/voices012015_concepts_of_the_global_south.pdf

Silva, E. L., & Menezes, E. M. (2005). *Metodologia da Pesquisa e Elaboração de Dissertação*. (4ª. ed.). Federal University of Santa Catarina. https://projetos.inf.ufsc.br/arquivos/Metodologia_de_pesquisa_e_elaboracao_de_teses_e_dissertacoes_4ed.pdf

Szapiro, M. (2017). Fronteiras tecnológicas e estratégias nacionais de desenvolvimento: análise de experiências internacionais. *Fundação Oswaldo Cruz*. https://saudeamanha.fiocruz.br/?s=Fronteiras+tecnol%C3%B3gicas+#.ZGTOPXbMLIU.

Tsui-auch, L. S. (2003). Learning Strategies of Small and Medium-sized Chinese Family Firms A Comparative Study of Two Suppliers in Singapore. *Management Learning, v. 34*(2), 201–220. https://doi.org/10.1177/135050760303400

United Nations Educational, Scientific and Cultural Organization – UNESCO. Institute for Statistics (UIS). http://data.uis.unesco.org/#.

United Nations Conference on Trade and Development - UNCTAD. (2014). *Transfer of Technology and knowledge sharing for development - Science, technology and innovation issues for developing countries.* https://unctad.org/system/files/official-document/dtlstict2013d8_en.pdf

United Nations Conference on Trade and Development – UNCTAD. (2019). *Digital Economy Repor 2019 - Value Creation and Capture: Implications for developing countries.* https://unctad.org/system/files/official-document/der2019_en.pdf

United Nations. (2023). *Methodology: Standard country or area codes for statistical use*. https://unstats.un.org/unsd/methodology/m49

Vesentini, J. W. (2013). *Geografia: o mundo em transição.* 2. ed. Ed. Ática.

World Intellectual Property Organization – WIPO. (2011). *World Intellectual Property Report: The Changing Face of Innovation*. WIPO Economics & Statistics Series. https://www.wipo.int/e-docs/pubdocs/en/intproperty/944/wipo_pub_944_2011.pdf

World Intellectual Property Organization – WIPO. (2021). *Global Innovation Index 2021*: *Tracking Innovation through the COVID-19 Crisis*. DOI: https://doi.org/10.34667/tind.44315**.**

World Intellectual Property Organization – WIPO. (2022). *Global Innovation Index 2022: What is the future of innovation-driven growth?* DOI: https://doi.org/10.34667/tind.46596.