Chapter 8

Comparative analysis of correlation between investments in science, technology & innovation and socioeconomic development in the face of global megatends

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ABSTRACT

In today's world, innovation guides a country's ability to adapt and conquer new markets, being investments in Science, Technology and Innovation (CT&I) one of the essential factors to keep up with global megatends. This work aimed to know the correlations between socioeconomic development indicators of 14 countries, including Brazil, and CT&I performance indicators. The results demonstrated high correlations between gross investments in CT&I and GDP, as well as the position in scientific production (R^2 = 0.85 in both analyzes). The correlation of investments in CT&I with the ranking of competitiveness was low; However, the innovation ranking showed median correlation (R^2 = 0.61) when related to the CT&I invested GDP percentages. The correlations between the innovation and competitiveness rankings with the HDI were also median (R^2 = 0.61 and R^2 = 0.56, respectively). CT&I indicators did not correlate with GDP growth rates and unemployment rates. Thus, this study infers that investing a higher percentage of GDP in CT&I can promote greater ability to innovate and human development in a country, and may be a political-economic strategy to be adopted.

Keywords: Science, Technology & Innovation; Socioeconomic development; Global megatendencies.

1 INTRODUCTION

Knowledge of global scenarios is the first step towards building synergistic and effective public strategies and policies. Analyzes of opportunities and threats, as well as clarity on global megatendencies, allow countries to prepare for constant changes that affect today's society and economy (MARCIAL, 2015).

The Brazilian economy has been formally in recession since the second quarter of 2014. Brazilian per capita product fell about 9% between 2014 and 2016, the growth rate of the Brazilian economy fell from 4% to 2% per year and the sector Brazilian public went from a primary surplus of 2.2% in 2012 and for primary deficit of 2.7% in 2016 (Barbosa Filho, 2017).

Accompanying economy falls, federal budget cuts were made in different areas, including Science, Technology & Innovation (CT & I). In 2014, Brazil allocated 1.27% of GDP in research activities, totaling R $ 7.3 billion (Davidovich, 2017).

Notwithstanding, in March 2017, the Ministry of Science, Technology, Innovations and Communications (MCTIC), which excludes personnel expenses, was limited to R $ 3.2 billion in 2017 - 44% lower than 44%. That what had been established in the budget law, and less than half of the 2014 committed budget. The 2018 budget was about one third of the destined eight years ago (Davidovich, 2017).

On March 29, 2019, contingency of 42.27% of the CT&I budget for 2018 was announced by the Federal Executive, having only R $ 2.947 billion for discretionary expenses in 2019 (SBPC, 2019).

Megatends are driven by the economy of innovation, whose expected scientific and technological advancement for the next decades will place humanity in a new era, where several areas stand out, such as: automation, robotics, nanotechnology, biotechnology, among others (MARCIAL, 2015). Information and communication technologies (ICTs) influence people's daily routine. Therefore, restricting the budget to CT&I is also to repress the adaptation in the face of constant changes, moving contrary to current megatendencies.

Given these cuts, the Brazilian scientific community, mainly coordinated by the Brazilian Academy of Science (ABC) and the Brazilian Society for the Progress of Science (SBPC), mobilize efforts to demonstrate to the rulers that resources for “science is not spent, it is investment! ” (ABC et al., 2017). It is also stated that all developed countries and even developing countries-such as those of the BRICS - They face education and science as a bet on the future.

An example contrary to the Brazilian Development Strategy would be that of the European Union (EU) that, given the 2009 crisis, began to invest more in CT&I, in order to stimulate acquired knowledge and innovation, as a strategy for promoting economic growth and, consequently, job creation and social welfare (European Union, 2018).

The investments went from € 17.8 billion (between 2002-2006) to € 53.2 billion (between 2007-2013), € 79 billion (between 2014-2020) and approximately € 100 billion is foreseen for the new program (between 2021-2027). These values make up approximately 2% of the European Commission Gross Domestic Product (GDP), far from the desired Europe 2020 strategy, which aimed to allocate 3% of GDP for research and innovation, and discrepant of other leaders of the world, such as: Korea do South (4.23% in 2015), Japan (3.29% in 2015) and the United States (2.79% in 2015) (Bourgeal; Lopez, 2017).

2 GLOBAL MEGATENDS AND INVESTMENTS IN CT&I FOR THE PROMOTION OF SOCIOECONOMIC DEVELOPMENT

Currently, economic growth is associated with future innovations, which requires improvements and investments in science and innovation from basic research to commercialization, from education to industrial digitization. The stimulation of innovation generates the adaptation that the market needs in the face of a changeable and unstable world. There are many socioeconomic challenges of modern life remedied or delayed by the advances of research and innovation, which help in the realization of the UN Agenda 2030 Sustainable Development Goals (UNESCO, 2019).

The future is uncertain, whose unpredictability and globalization reverberates in unlikely, unpredictable and highly disruptive changes in a short time. Nevertheless, global - social, economic, political, environmental or technological megatendings remain megatendencies that are slow, but as they are rooted, they exert lasting influence on many activities, processes and perceptions (BOUMPHREY;

BREHMER, 2017). This relative stability allows you to predict a likely medium to long -term future, with some degree of confidence, and guide the governance of public and private organizations today.

According to the report of the Organization for Economic Cooperation and Development (OECD), the megatends that affect CT&I and, therefore, can use their tools to permeate the instability of everyday life and meet the expected economic and social development, are grouped In eight thematic areas, namely: demography; natural resources and energy; climate change and environment; globalization; Government role; economy, employment and productivity; society; and health, inequality and well-being (OECD, 2016).

The economic development of countries is increasingly based on innovation based on scientific and technological development. It is no coincidence that several countries, such as the United States and China, have placed innovation as a central axis of their growth strategies after the 2008 crisis (Brazil, 2016).

The challenge of promoting the ability to convert ideas to value is a predominant factor for the success of a country's business activity. In a growing competitive scenario, technological innovations add value to products, as well as gains in production processes. The promotion of an innovative culture is fundamental for nations that seek to expand their markets, the generation of qualified jobs, the increase in workers' income and the improvement of the quality of life of citizens (BRAZIL, 2016).

In this context, many international indexes are widely used by companies and governments to direct investment strategies and partnerships, as they group different parameters in specific areas and rank countries, such as the Global Innovation Index and the global competitiveness index, which reflect the capacity of competitiveness and innovation between countries. The Human Development Index (HDI), in turn, compares the degree of economic development and the quality of life offered to the population.

In the National CT&I 2016-2022 strategy, they stand out as challenges for Brazil: i) the search for a pairing trajectory with the most developed nations in the field of CT&I; ii) the promotion of innovation being crucial for increasing productivity and competitiveness in a scenario of accelerated market opening process; and iii) sustainable development and productive and social inclusion (BRAZIL, 2016).

CT&I aids the world to act in a “blue ocean” in the face of global megatends. The “blue ocean” strategy strives and innovating in the value proposition, making the current competition competition irrelevant (KIM; MAULBORGNE, 2005).

Innovation of value is of paramount importance to generate a sustainable organizational environment and, therefore, the association of technologies with products and processes, being in the forefront of scientific knowledge, associating employees with high training and highly engaged, makes research and Primordial development to meet the desired business and institutional growth.

Thus, insufficient investment in CT&I triggers an unsustainability in economic growth and a low innovation power in the country - perpetuating processes and product generation only in the “red ocean”. According to Kim & Maulborgne, Red Ocean is the known market, where competitors compete for the same markets, in which it provides intense competitiveness (KIM; MAULBORGNE, 2005).

The socioeconomic development of nations has shown an increasingly direct relationship with scientific and technological development. Positioning Brazil among the world's most prominent countries in research and innovation is a major challenge. Identify the correction between investments in CT&I and the socioeconomic development of major world leaders, including Brazil, may be paramount for the country to advance the sustainable recovery of its economy.

Therefore, this work aimed to identify the relationship between CT&I indicators and socioeconomic development in 2018, through comparative analysis between world economic leaders, including Brazil, such as the United States, China, Germany, Israel , Argentina, among others, selected by its significance in terms of CT&I.

3 METHODOLOGY

For comparative analyzes between socioeconomic and CT&I indicators to be performed, some countries were chosen for data collection. The choice was based on different parameters, namely: (i) countries that have active cooperation with Brazil, that is, which present cooperation agreements in the area of CT&I in force and various activities in progress; and (ii) exponent countries in scientific production, innovation and competitiveness in the world.

Among all countries fall into the above characteristics, a categorization was performed in order to balance the number of countries according to the following characteristics: GDP, HDI and how much invest in CT&I (GDP percentage). Four groups were created, whose countries in each group have the following common indicators:

Group 1) leading countries of the world economy (larger GDP), with high HDI (developed countries) and significant investments in CT&I;

Group 2) Leading countries of the world economy or with significant GDP (over $ 1 trillion/year), with median HDI (developing countries) and presenting representativeness in CT&I;

Group 3) Countries with lower GDP (below $ 1 trillion/year), with high HDI (developed countries) and high percentage of GDP invested in CT&I; It is

Group 4) Countries with lower GDP (below $ 1 trillion/year) and low investment in CT&I.

The countries chosen and grouped in each group can be viewed in Table 1. Categorization in groups only assisted in the choice of countries for the study. The analyzes described below did not consider correlations in each group distinctly - all grouped in a single block.

Table 1 - selection of countries for comparative analysis between socioeconomic indicators and performance in ct&i

Group 1	**Group 2**	**Group 3**	**Group 4**
U.S	China	Netherlands	Turkey
Japan	India	Switzerland	Argentina
Germany	**Brazil**	Israel	Chile
South Korea	Mexico	--	--

Data source: DESJARDINS, 2018; IMF, 2018; UNDP, 2018.

In order to infer the correlation of CT&I indicators with the social and economic development of selected countries, indicators were collected that expressed the country's wealth - such as GDP (US $) and GDP growth rate (%) - and the quality of life of the population - unemployment rate (%) and the Human Development Index (HDI) (IMF, 2019; UNDP, 2018).

Additionally, development indicators in CT&I were identified in 2018, such as: gross investments in CT&I (at US $) (Desjardins, 2018); CT&I investment percentages regarding GDP (%) (UNDP, 2018); Position in the Global Innovation Index 2018 (Dutta et al., 2018); Journal & Country Rank 2017 position (SJR, 2017); and position in the global competitiveness index 2018 (SCHWAB, 2018).

From the survey of socioeconomic development data and the CT&I indicators of the selected countries, correlation analyzes were performed, by defining line of linear or exponential trend lines of the data. From the trend line, the determination coefficients (R2) were identified, who, finally, infers the degree of correlation between the data collected. In this study, we defined as high correlation data that have R2 above 0.8. When the R2 was close to 0.6, a median correlation was considered; R2 below 0.5 were considered with low correlation or non -existent correlation.

Therefore, this is an applied, quantitative, descriptive, experimental and ex post factual research.

4 DATA ANALYSIS

4.1 IMPACTS OF INVESTMENTS IN CT&I ON THE DEVELOPMENT OF CT&I ITSELF

Socioeconomic development and CT&I performance data from selected countries can be viewed in Table 1.

The countries that invest the most in CT&I (in US $) are, in descending order, the United States and China. Brazil, in turn, is in seventh position among the selected countries. Chile is the country that is least investing in CT&I among the countries analyzed here, both regarding the gross investment values and the percentage of GDP, being the smallest GDP as well. Although Israel is the second smallest GDP, its gross investment in CT & I equates to those of Switzerland and Mexico. This is because Israel, like South Korea, is the country that most bets its development strategies in CT&I regarding the percentage of GDP (4.3%).

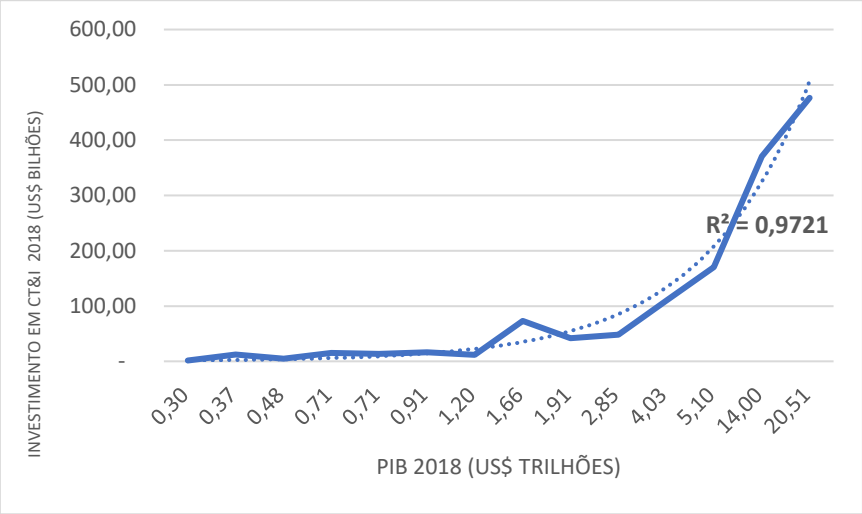
Table 1 - comparison between socioeconomic and developmental indicators in ct&i from 14 countries.

	2018	Estados Unidos	Japão	Alemanha	Coreia do Sul	China	India	Brasil	México	Países Baixos	Suíça	Israel	Turquia	Argentina	Chile
Indicadores Socioeconômicos	PIB 2018 (US$ trilhões)	20,51	5,10	4,03	1,66	14,00	2,85	1,91	1,20	0,90	0,71	0,37	0,71	0,48	0,30
	Taxa de crescimento do PIB 2017-2018 (%)	2,90%	1,10%	1,90%	2,80%	6,60%	7,30%	1,40%	2,20%	2,80%	3%	3,60%	3,50%	-2,60%	4,00%
	Taxa de desemprego 2018 (%)	4,40%	2,80%	3,70%	3,80%	4,70%	3,50%	12,90%	3,50%	4,90%	4,80%	4,30%	11,30%	8,70%	7,00%
	IDH 2018	0,924	0,909	0,936	0,903	0,752	0,640	0,759	0,744	0,931	0,944	0,903	0,791	0,825	0,846
Indicadores de CT&I	Investimentos em CT&I 2018 (US$ bilhões)	476,50	170,50	109,80	73,20	370,60	48,10	42,10	11,60	16,50	13,70	12,30	15,30	5,00	1,50
	Investimentos em CT&I 2018 (% do PIB)	2,80%	3,30%	2,90%	4,20%	2,10%	0,60%	1,20%	0,60%	2%	3%	4,30%	1%	0,60%	0,40%
	Global Innovation Index 2018 - GII	6	13	9	12	17	57	64	56	2	1	11	50	80	47
	Scimago Journal & Country Rank 2017 - SJR	1	6	4	13	2	5	14	28	15	17	33	19	44	45
	Global Competitiveness Index 2018 - GCI	1	5	3	15	13	58	72	46	6	4	20	61	81	33

Data source: DESJARDINS, 2018; DUTTA et al., 2018; IMF, 2018; SCHWAB, 2018; SJR, 2017; UNDP, 2018.

The correlation between GDP and investments in CT&I in 2018 (in US $) demonstrate high exponential correlation (R2 = 0.85), as shown in graph 1. However, when compared the GDP of selected countries with percentages of GDP invested in CT & I was not evidenced correlation (R2 = 0,13).

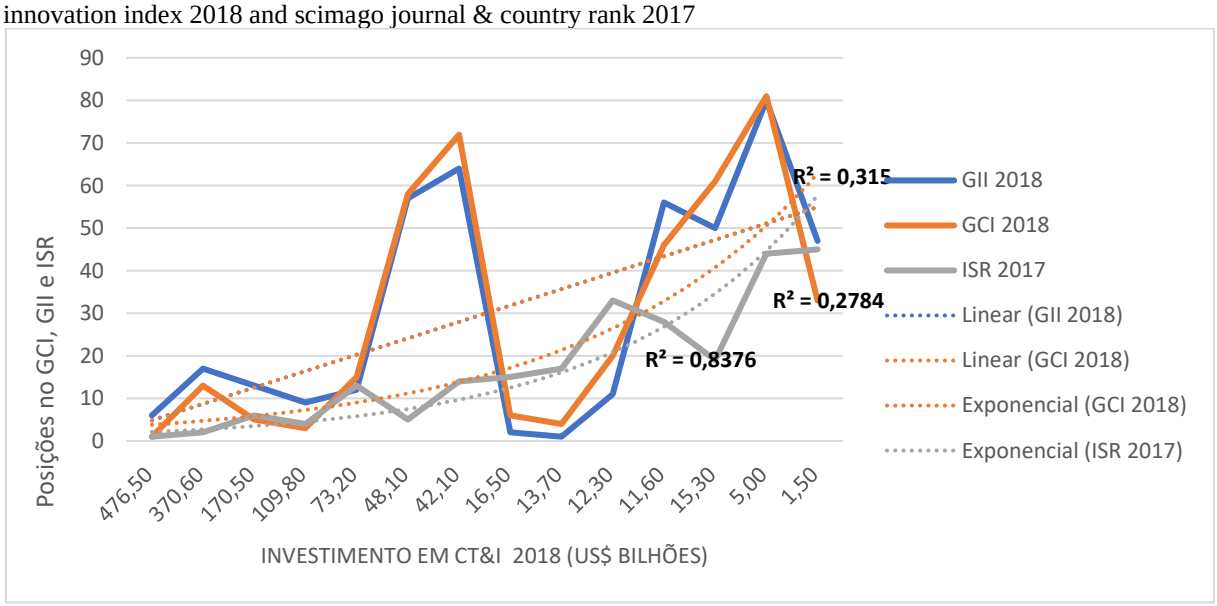
Graph 1 - correlation between gdp 2018 and investments in ct&i in 2018, in gross values (us $)



Data source: DESJARDINS, 2018; IMF, 2019.

Correlations between CT&I was also evaluated in 2018 (Gross Values in US $ and PIB percentage) and positions at Global Competitiveness Index 2018 (GCI), Global Innovation Index 2018 (GII) and SCIMAGO JOURNAL & COUNTRY RANK 2017 (SJR) (Graphs 2 and 3).

Graph 2 - correlation between investments in ct&i in 2018 (us $ billion) and positions at global competitiveness index 2018, global innovation index 2018 and scimago journal & country rank 2017



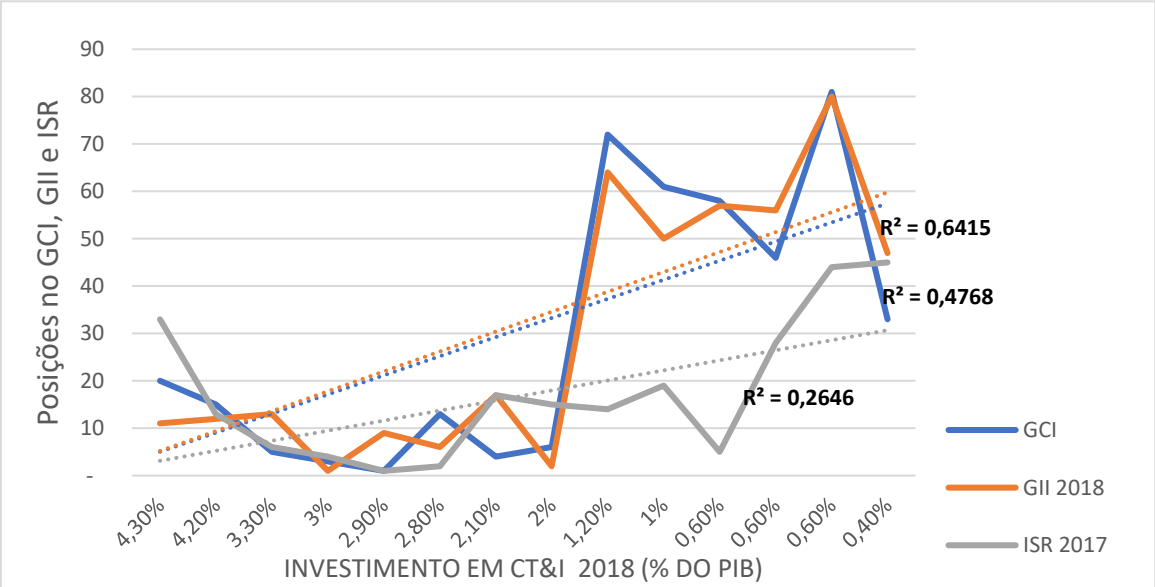
Data source: desjardins, 2018; dutta et al., 2018; schwab, 2018; sjr, 2017.

In graph 2, it appears that there is high exponential correlation between how much it really invests in CT&I (US $) and the position in SJR (R2 = 0.85). Nevertheless, the linear correlation of the GII and the exponential correlation of the CGI with gross investments in CT & I were low (R2 = 0.43 and R2 = 0.32,

respectively). This can be explained because the SJR precipitously considers the numbers of publications and citations - concrete results of investments in CT&I and, therefore, reflect the volume of research projects and granted scholarships.

CGI and GII are more complex rankings, considering more factors for determining the index that determines the ranking position. GII, for example, in addition to considering the number of patents, takes into account business, politicians and regulatory environments, as well as human resources, infrastructure, market sophistication and business. GCI, on the other hand, considers confidence in the analyzed market, such as transparency, property rights, security, capital, among others.

Graph 3 - correlation between ct&i's pib percentages in 2018 and positions at global competitiveness index 2018, global innovation index 2018 and scimago journal & country rank 2017



Data source: DUTTA et al., 2018; SCHWAB, 2018; SJR, 2017; UNDP, 2018.

Graph 3 demonstrates the correlation in rankings according to the percentage of GDP invested in CT&I. In this context, SJR has no high correlation when compared to gross investments (R2 only 0.26). GCI correlations for gross or GDP percentage investments were similar (R2 close to 0.45 for both). The GII presented slightly more pronounced linear correlation when considered the percentage of GDP invested in CT & I, although the correlation is still moderate (R2 = 0.61).

4.2 IMPACTOS DOS INVESTIMENTOS EM CT&I PARA O DESENVOLVIMENTO SOCIOECONÔMICO

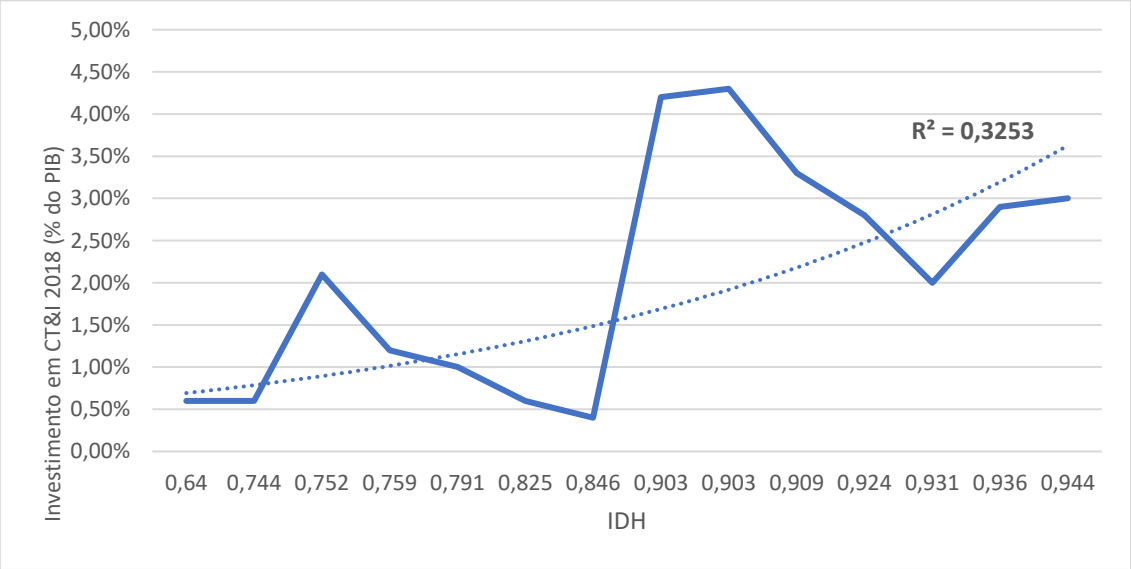
In the previous section, they were evaluated as investments in CT&I provide better positions of countries in research, innovation and competitiveness. It uses the discourse that investment in CT&I provides the country's economic development and job creation.

Thus, in this section we seek to analyze the correlations between investment in CT&I and positions in SJR, GCI & GII and parameters of economic development (GDP growth rate) and social (human development index - HDI and unemployment rate).

With regard to the correlations between GDP growth rates and investments in CT&I - both gross investment (US $) and the percentage of GDP - as well as the positions in Global Innovation Index and the global competitiveness index, were not found any correlations for the year 2018 (R2 negative - data not demonstrated).

Considering the 2018 HDIs, correlation analysis with investments in CT&I in the same year showed that when the gross values (US $) were considered, there was no correlation identification in the countries analyzed R2 = 0.008); However, when considering the GDP investment percentage in CT&I, the correlation was moderate (R2 = 0.42), as shown in graph 4. It is noteworthy that the HDI is a complex and multifactorial index, which includes as one of its parameters The percentage of GDP invested in CT&I, not gross investment.

Graph 4 - correlation between human development indexes (hdi) and ct&i's gdp percentages in 2018

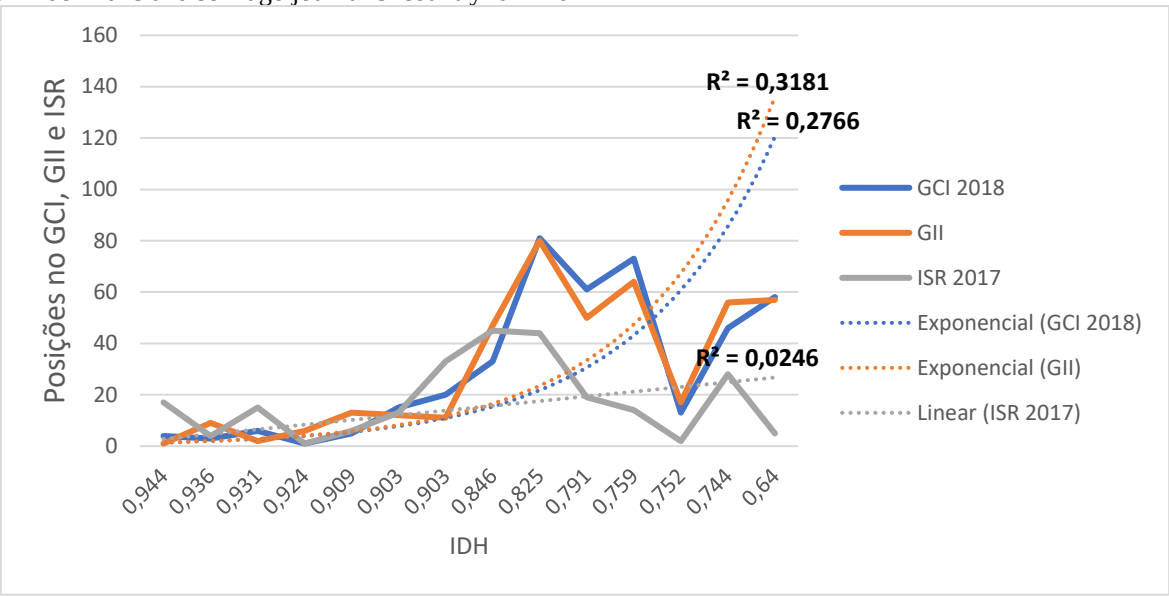


Data source: undp, 2018.

When the HDI correlations were evaluated in 2018 and the positions in GCI, GII and SJR, there were median exponential correlations in the first two (R2 close to 0.6) and no correlation with the last (negative R2) (chart 5).

When analyzing unemployment rates and investments in CT&I - gross values (US $) and GDP percentages - low correlations were identified (R2 = 0.2 for both).

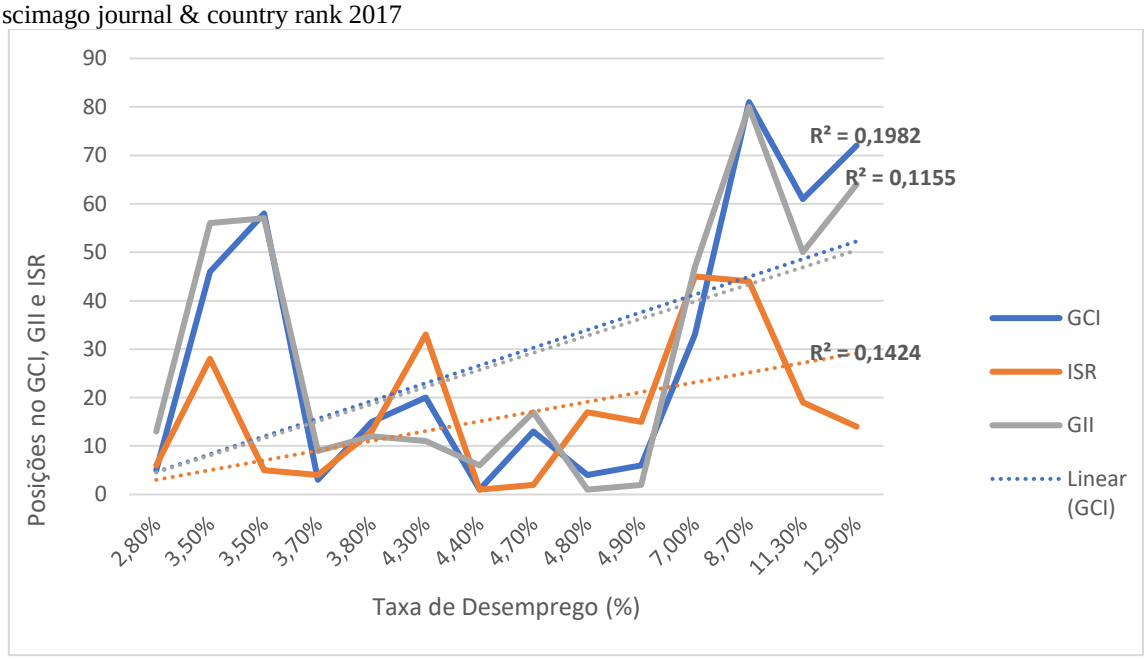
Graph 5 - correlation between human development indexes (hdi) and positions at global competitiveness index 2018, global innovation index 2018 and scimago journal & country rank 2017



Data source: dutta et al., 2018; schwab, 2018; sjr, 2017; undp, 2018.

As demonstrated in Graph 6, correlations between unemployment rates of 2018 and GCI, GII and SJR positions were also inexpressive (R2 below 0.2).

Graph 6 - correlation between unemployment rate 2018 (%) and the global competitiveness index 2018, global innovation index 2018 and scimago journal & country rank 2017



Data source: dutta et al., 2018; imf, 2019; schwab, 2018; sjr, 2017.

5 DISCUSSION

According to data raised and analyzed in this research, countries that present high GDP adopt the strategy of investing significant appeals in CT&I, such as the United States and China.

Nevertheless, there are moderate GDP countries that adopt the strategy of allocating a high percentage of their GDP, such as Netherlands, Switzerland and Israel. Brazil, in turn, although not the country that invests little in CT&I, such as Chile, is in the seventh position among the selected countries.

By evaluating the correlation of the country's degree of innovation, inferred by the position in the global Innovation Index, there was a greater correlation when the percentage of invested GDP was considered than when considered the gross investment value in CT&I.

Brazil ranks 64th at the Global Innovation Index 2018 (Dutta et al., 2018) and 72nd in the global competitiveness index 2018 (Schwab, 2018), which demonstrates little adherence to the strategy of the "blue ocean" theory, not creating Business environments and conducive regulation to stimulate innovation and therefore greater competitiveness. Nevertheless, it is the 14th in the term of scientific publications at the Journal & Country Rank 2017 Scimagus (SJR, 2017), and may indicate that there are no few resources being invested in the country in research -as the comparative table itself presented -but the strategy Business in investing in innovation, here inferred from the percentage of GDP that the country invests in CT&I, can be the limiting factor.

HDI correlations and positions at Global Competitiveness Index 2018, Global Innovation Index 2018 and the Journal & Country Rank 2017 Scimagus demonstrate moderate correlations in the first two. The three correlated indices are multifactorial and have parameter similarities. This fact may possibly explain the presence of correlation between the evaluated countries.

With the world increasingly inserted in Industry 4.0, digital transformation and adaptation to global megatências becomes indispensable. In this context, perhaps investing in CT&I does not necessarily provide more jobs, contrary to what many state and as shown in the absence of correlation between CT&I indicators and unemployment rates.

This is possibly explained because machines today are increasingly replacing human labor and thus necessarily the population will have to invest more in training. Investments in CT&I, as well as involving resources in granting research scholarships, assist in the formation of human resources; However, although it has not been a data analyzed in this work, investment in education must have more correlation with the unemployment rate than the investment in CT&I itself.

It is noteworthy that although all the above correlation data is categorized as statistically insignificant, since they correspond to R2 less than 0.95 (error above 5%), they can help infer trends. It is also noteworthy that in this study countries were chosen that had a significant relationship with Brazil within the scope of CT&I and do not necessarily represent a considerable sample number for statistical analysis.

6 CONCLUSIONS

It is inferred that countries that adopt as a strategy for a greater percentage of their GDP in CT&I are those that use the most of innovation to promote their development. It is not necessarily the gross amount

of invested in CT&I that defines the degree of innovation of a country, but a prioritization that the country gives to the area. It is possible for countries that invest a higher percentage of their GDP in CT&I also invest more in providing dynamic business environments, with regulation that bureaucracy and provides security to processes, which stimulate creativity and innovation.

Countries with greater degree of innovation and economic competitiveness have also been found to also have better rates of socioeconomic development. Infect that allocating a higher percentage of GDP to CT&I better the position in the innovation ranking, can be a strategy that helps the country improve its human development.

Given that there was no correlation between investments in CT&I and unemployment rate, it is inferred that global digitization megate and invest in it through research and innovation can have a negative impact on unemployment rate. Therefore, stating that investment in CT&I can be mistaken, and it should be said that the population is required of the greater technical training. The same can be verified when the absence of investment correlation and the percentage of GDP growth has been observed.

In this study, all the above correlations are inferences, not statements. However, there are indications of positive correlation of investments in CT&I and the social and economic development of a country.

With the perspective of the study, we suggest more accurate comparative analyzes between the countries and/or the selected groups and Brazil, especially in the indicators that presented high or moderate correlations, in order to identify good strategies that could be used for possible public policies. Additionally, the sample or indicators can be expanded. In this study, some indicators used were indices that, because they are multifactorial, can distort the direct correlation performed here. Therefore, a proposal would be to choose some specific parameters of each index and make the direct correlation.

REFERENCES

ABC; ANDIFES; CONFAP; CONSECTI; FÓRUM NACIONAL DE SECRETÁRIOS MUNICIPAIS DA ÁREA DE CIÊNCIA E TECNOLOGIA; SBPC. Orçamento de CT&I para 2018: tragédia anunciada! Jornal da Ciência, 19 dez. 2018. Disponível em: < http://portal.sbpcnet.org.br/noticias/orcamento-de-cti-para-2018-tragedia-anunciada/ >. Acesso em: 12 nov. 2017.

BARBOSA FILHO, F.H. A crise econômica de 2014/2017. Estudos avançados, São Paulo, v. 31, n. 89, jan.-abr. 2017. Disponível em: <http://www.scielo.br/scielo.php?script=sci_arttext&pid=s0103-40142017000100051>. Acesso em: 12 nov. 2018.

BOUMPHREY, S.; BREHMER, Z. Megatrend Analysis Putting the Consumer at the Heart of Business. Euromonitor International, 2017. Disponível em: < http://go.euromonitor.com/rs/805-KOK-719/images/wpMegatrendAnalysis.pdf>. Acesso em: 14 nov. 2018.

BOURGEAIS, V.; LOPEZ, A.H. First estimates of Research & Development expenditure R&D expenditure in the EU remained stable in 2016 at just over 2% of GDP Almost two thirds spent in the business sector. Eurostat Press Office, n. 183, dez. 2017. Disponível em: <https://ec.europa.eu/eurostat/documents/2995521/8493770/9-01122017-AP-EN.pdf/94cc03d5-693b-4c1d-b5ca-8d32703591e7>. Acesso em: 12 nov. 2018.

BRASIL. MCTIC - MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES. ENCT 2016-2022, Estratégia Nacional de Ciência, Tecnologia e Inovação. Ciência, Tecnologia e Inovação para o Desenvolvimento Social. Brasília, 2016. Disponível em: < http://www.finep.gov.br/images/a-finep/Politica/16_03_2018_Estrategia_Nacional_de_Ciencia_Tecnologia_e_Inovacao_2016_2022.pdf>. Acesso em: 12 nov. 2018.

DAVIDOVICH, L. Financiamento em crise - quais são as alternativas para atenuar o impacto dos cortes do orçamento federal no esforço nacional em Pesquisa e Desenvolvimento. Revista Pesquisa FAPESP, São Paulo, ed. 256, jun. 2017. Disponível em: <http://revistapesquisa.fapesp.br/2017/06/19/financiamento-em-crise/>. Acesso em: 12 nov. 2018.

DESJARDINS, J. Innovators wanted: these countries spend the most on R&D. World Economic Forum, 18 Dec 2018. Disponível em: <https://www.weforum.org/agenda/2018/12/how-much-countries-spend-on-r-d/ >. Acesso em: 21 abr. 2018

DUTTA, S.; LANVIN, B.; WUNSCH-VINCENT, S. Global Innovation Index 2018. Energizing the World with Innovation. Disponível em: <https://www.globalinnovationindex.org/Home>. Acesso em: 12 nov. 2018.

EUROPEAN UNION. Science, Research and Innovation Performance of the EU 2018 Key Findings. Publications Office of the European Union, Luxembourg, 2018. Disponível em: < https://ec.europa.eu/info/sites/info/files/srip/rec-17-015_srip-brochureb5_en_v10_outec_20180412.pdf>. Acesso em: 12 nov. 2018.

IMF - INTERNATIONAL MONETARY FUND. World Economic Outlook (April 2019). Disponível em: < https://www.imf.org/external/datamapper/datasets/WEO>. Acesso em: 21 abr. 2019.

KIM, C.; MAULBORGNE, R. Estratégia do oceano azul: como criar novos mercados e tornar a concorrência irrelevante. Elsevier, Rio de Janeiro, 2005.

MARCIAL, E. C. Megatendências mundiais 2030: o que entidades e personalidades internacionais pensam sobre o futuro do mundo? contribuição para um debate de longo prazo para o Brasil. IPEA, Brasília, 2015. Disponível em: < http://www.ipea.gov.br/portal/images/stories/PDFs/livros/livros/151013_megatendencias_mundiais_2030.pdf >. Acesso em: 07 maio 2019.

OECD - ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT. Science, Technology and Innovation Outlook 2016. Megatrends affecting Science, technology and innovation, 2016. Disponível em: < https://www.oecd.org/sti/Megatrends%20affecting%20science,%20technology%20and%20innovation.pdf>. Acesso em: 14 nov. 2018.

SBPC – SOCIEDADE BRASILEIRA PARA O PROGRESSO DA CIÊNCIA. Pontes: Corte de 42% no orçamento deixa MCTIC "com a corda no pescoço". JC Notícias, ed. 6125, abr. 2019. Disponível em: < http://jcnoticias.jornaldaciencia.org.br/3-pontes-corte-de-42-no-orcamento-deixa-mctic-com-a-corda-no-pescoco/ > Acesso em: 22 abr. 2019.

SJR - SCIMAGO JOURNAL & COUNTRY RANK. International Science Ranking 2017. Disponível em: < https://www.scimagojr.com/countryrank.php?year=2017 >. Acesso em: 12 nov. 2018.

SCHWAB, K. The Global Competitiveness Report 2018. World Economic Forum, Genebra, 2018. 671p. Disponível em: <http://reports.weforum.org/global-competitiveness-report-2018/ >. Acesso em: 21 abr. 2019.

UNDP - UNITED NATIONS DEVELOPMENT PROGRAMME. Human Development Indices and Indicators 2018. Statistical updates. Disponível em: <http://www.hdr.undp.org/sites/default/files/2018_human_development_statistical_update.pdf>. Acesso em: 12 nov. 2018.

UNESCO – Organização das Nações Unidas para a Educação, a Ciência e a Cultura. UNESCO e os Objetivos de Desenvolvimento Sustentável. Disponível em: <http://www.unesco.org/new/pt/brasilia/post-2015-development-agenda/unesco-and-sustainable-development-goals/ >. Acesso em: 12 fev. 2019.