ISSN: 2755-0168

Journal of Biotechnology & Bioinformatics Research

SCIENTIFIC Research and Community

Review Article

Open Access

Science, Technology, and Innovation in Latin America and the Caribbean 2023

Oscar Cobar[1,2]* and Stella Cobar[3]

[1]Pharmacogenomics and Nutrigenomics Research Laboratory, School of Chemical Sciences and Pharmacy, University of San Carlos, Guatemala

[2]Biomedical Sciences Ph.D. Program, School of Medical Sciences, University of San Carlos, Guatemala

[3]School of Chemical Sciences and Pharmacy, University of San Carlos, Guatemala

ABSTRACT

In this document we provide several indicators related to Science, Technology and Innovation and reflections on what we must do in Latin America, Ibero-America -Latin America including Brazil, Spain, and Portugal- and the Caribbean so that they become the fundamental axes for the society's development.

***Corresponding author**

Oscar Cobar, Pharmacogenomics and Nutrigenomics Research Laboratory, School of Chemical Sciences and Pharmacy, University of San Carlos, Guatemala.

Received: December 23, 2023; **Accepted:** December 27, 2023; **Published:** January 05, 2024

The Knowledge Society

Currently, it is widely accepted that Education, Science, Technology, and Innovation are the axes to advance the well-being of countries and their societies, since they create sustainable development.

This is key in developing countries with efforts to challenge the Knowledge Society.

The development of science, technology and innovation is a stratifying element of countries, their aspirations for the future and the place they occupy around the world.

The concept of "Knowledge Society" (a society in which the generation, transmission, and conversion of scientific knowledge into technology is its most precious asset), begins from the continuous and accelerated advance of science, guided by scientific research and technology, as the main responsible for the "boom" of knowledge that we have been experiencing in recent years.

That has driven the socioeconomic development of the "first world" and "emerging" economies, which produce scientific-technological policies that allow them to adapt to the dizzying pace at which new knowledge is generated and the speed at which it will become obsolete.

The knowledgement generation is, therefore, the common thread of Technological Development and Innovation, it is the fundamental ingredient to drive the Knowledge Society, the model based on science, which allows:

- Fighting poverty,
- Strengthen competitiveness,
- Join to the era of digitalization and emerging sciences,
- Strengthen democracy by reducing social inequalities shrinking the gap between "developed" and "developing" societies.

Scientific Policy Guidelines

If we could, like the United Nations Educational, Scientific and Cultural Organization (UNESCO), we understand that Science Policy is the set of provisions (the legal system) that the nations must adopt to promote scientific research, technological development, and innovation [1,2].

Success is to be determined by the best knowledge we have of the factors that condition it, the goals it pursues and its operative implementation, execution, and control.

A State Policy should be to contribute to the development of a Nation whose economy is based on generating knowledge and appropriate it, which has an impact on the enhancement of the societies quality of life.

It must have a long-term vision to become a fundamental part of the country's economic and social development strategy, which fosters the rise and social appropriation of science, technology, innovation, and science education, which play a key role in the socioeconomic, cultural, and environmental development.

The policy must lie on the general guidelines that provide the organizational structures for planning, organization, and national consolidation.

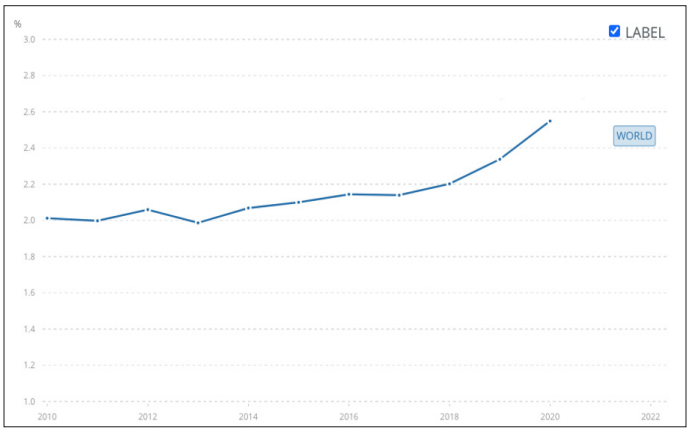
Besides what we expect from science, technology, and innovation as well as all the actions that ensure the training of scientific and technical work forces, and the adequacy of scientific research to promotion of its achievements to social practice.

The World Bank Science and Technology Indicators

The World Development Indicators is a compilation of relevant, high-quality, and internationally comparable statistics about global development.

The database contains 1,400 time series indicators for 217 economies and more than 40 country groups, with data for many indicators going back more than 50 years, was consulted on December 12, 2023 [3].

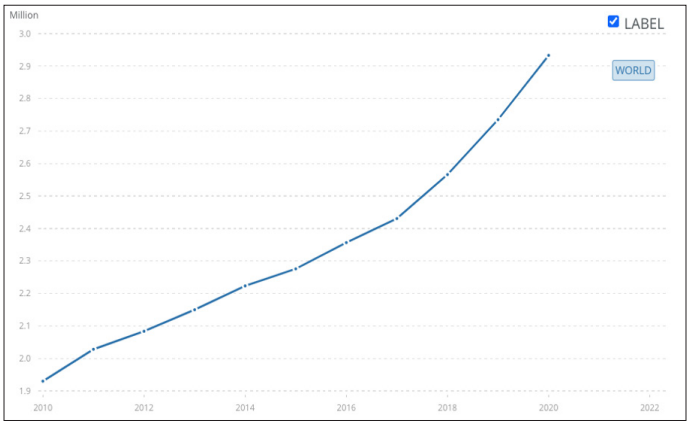
Research and Development Expenditure (% of GDP)



https://data.worldbank.org/topic/science-and-technology?end=2022&start=2010&view=chart

Scientific and Technical Journal Articles

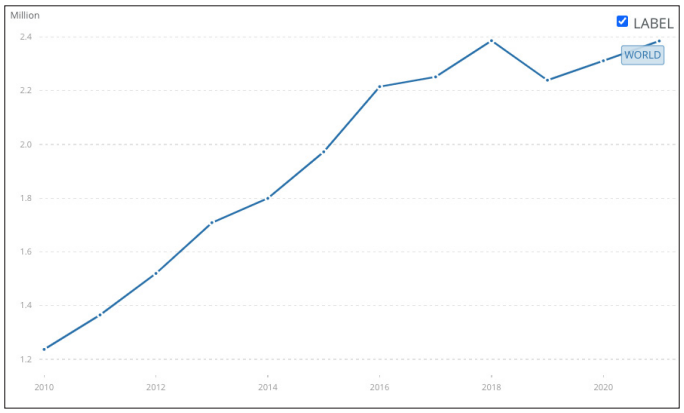
National Science Foundation, Science and Engineering Indicators



https://data.worldbank.org/indicator/IP.JRN.ARTC.SC?end=2022&start=2010&view=chart

Patent Applications, Residents

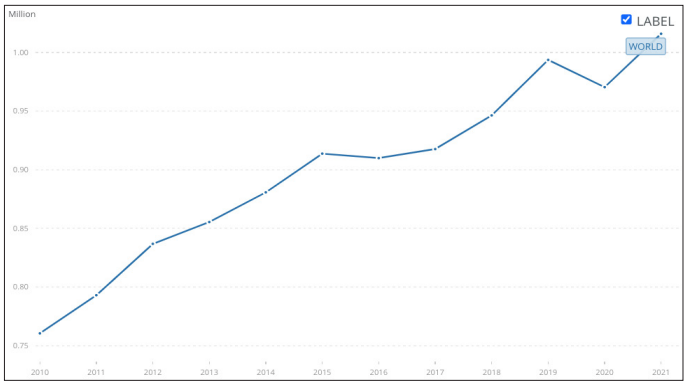
World Intellectual Property Organization (WIPO), WIPO Patent Report:
Statistics on Worldwide Patent Activity



https://data.worldbank.org/indicator/IP.PAT.RESD?end=2021&start=2010&view=chart

Patent Applications, Nonresidents

World Intellectual Property Organization (WIPO), WIPO Patent Report: Statistics on Worldwide Patent Activity.



https://data.worldbank.org/indicator/IP.PAT.NRES?end=2021&start=2010&view=chart

Science and Technology in Latin America and the Caribbean

Since the beginning of the 21st century, an increasing number of countries around the world have gradually been increasing their science and technology activities, and recently innovation, in the face of the challenges imposed by the Knowledge Society, to simplify comparison and the global exchange of information with the purpose of deepening their knowledge and their use as a political instrument for decision-making instruments for the analysis of Science, Technology and Innovation [4].

The data presented are available on the website of the "Network of Science and Technology Indicators" (RICYT), whose latest report contains information on the different countries up to 2021 provided by the countries National Science and Technology Agencies (ONCYTs), the Gross Domestic Product data from the International Monetary Fund and the population from the latest national surveys in each country [5, 6].

The Economic Context

When we analyze the GDP evolution of 2012-2021, It can be noticed in the last year a post-pandemic economic recovery in all geographical blocks, exceeding the levels of 2019.

The Latin America and the Caribbean GDP shows a 21% rising between 2012 and 2021, reaching more than ten billion PPP dollars -Purchasing Power Parity- in 2021.

Ibero-America, on the other hand, shows a growth of similar magnitude between 2012 and 2021, reaching almost thirteen billion PPP dollars (Figure 1).

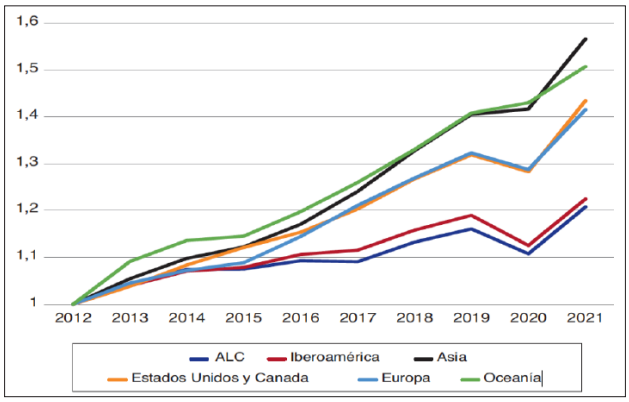


Figure 1: Percentage Evolution of GDP in Blocks of Selected Countries (2012-2021)
Source: RICYT database; www.ricyt.org

In 2021, there was evidence of an economic recovery after the 2020 GDP contraction in all geographical blocks because of the COVID-19 pandemic.

However, comparatively, the speed of recovery was not the same in all cases: Asian countries were the fastest growing, followed by the alliance United States, Canada, and Europe, while LAC and Oceania experienced a more moderate recovery.

Investment in R+D

The Latin American, the Caribbean and Ibero-America country's economy, investment in R+D grew again in 2021 after the sharp contraction suffered in 2020 (Figure 2) [7].

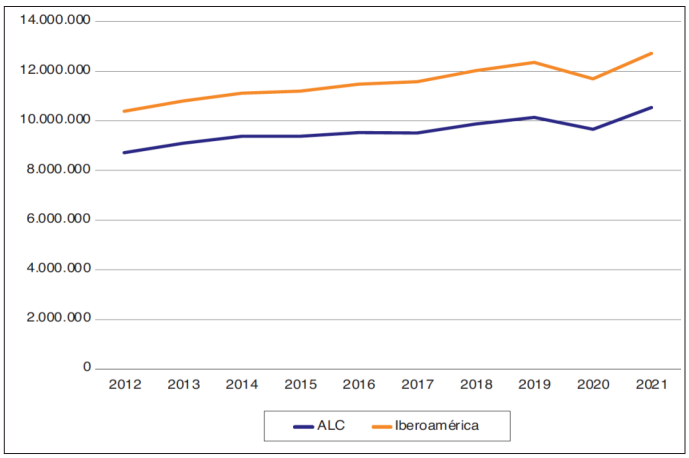


Figure 2: Evolution of the GDP of LAC and Ibero-America (Million PPP Dollars)
Source: RICYT database; www.ricyt.org

Comparing the level of investment in 2021 with that of the year before the pandemic, the recovery is slightly greater in the case of Ibero-America, driven by the evolution of Spain and Portugal.

In the long term, Latin American countries invested 19% more than at the beginning of the period analyzed here, while resources allocated to R+D in Ibero-America grew by 27%.

It is important remark that LAC investment represents only 2.2% of the global total.

The Latin American and Caribbean region is also characterized by a "Concentration Phenomenon" wherein Brazil, Mexico, and Argentina account for 84% of its total investment.

In terms of GDP, Ibero-American countries made an investment that represented 0.77% of the region's gross product in 2021, while LAC reached 0.61%.

Portugal and Spain are the Ibero-American countries that make the most relative effort in R+D, investing 1.68% and 1.43% of their GDP respectively.

Brazil is the only Latin American country whose investment represents more than 1% of its GDP, Argentina invested 0.52% while the rest of the countries invest less than 0.50% of their product in R+D.

Comparatively, investment by LAC and Ibero-American countries continues to be lower than by industrialized countries.

For example, Israel is the country with the highest level of investment, allocating 5.56% of its GDP to R+D activities.

It is followed by Korea with an investment close to 5% and then the United States, Japan, Germany, and Finland close to 3% of their GDP.

Human Resources Dedicated to R+D

The number of full-time equivalent (FTE) researchers in Ibero-America has grown by 45% between 2012 and 2021, from 436,521 to 634,421.

Regard the distribution of human resources by sector they carry out their tasks, we see that the higher education is the most significant, since 58% of researchers in 2021 carried out their activities in the university environment.

30% of researchers in the region worked in companies (both public and private) and 11% worked in R+D institutions belonging to the public sector.

Investment in Ibero-American R+D rise from 77 billion PPP dollars in 2012 to more than 98 billion (Figure 3).

In 2021, 49% of that amount was funded by the government and 42% by companies, while funding from the higher education sector accounted for 5% of total investment, the foreign sector 4%, and private non-profit organizations 1%.

When analyzing how the funds allocated to R+D activities are executed by sector, we see that the distribution is different.

The government executes 22% of the investment, while higher education institutions and businesses 36% and 41% each.

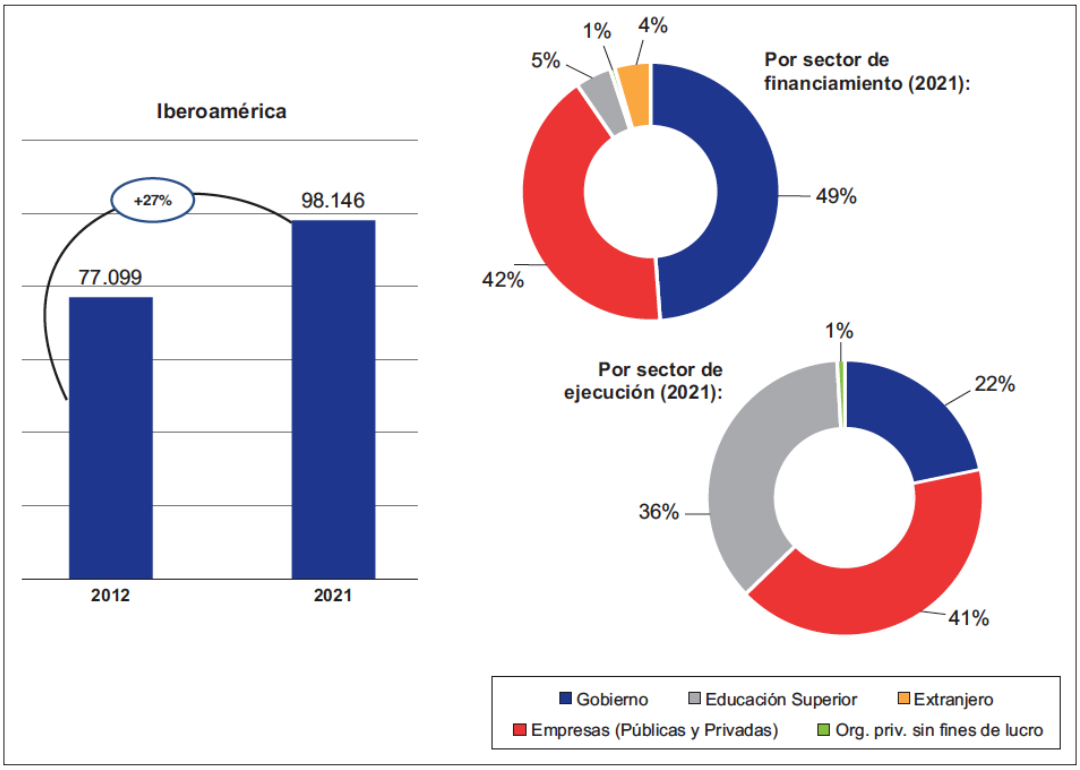


Figure 3: Sectorial Distribution of R+D Investment in Ibero-America
Source: RICYT database; www.ricyt.org

In LAC countries as a whole, investment in R+D experienced a lower growth than in Latin America, increasing by 19% between 2012 and 2021 (Figure 4).

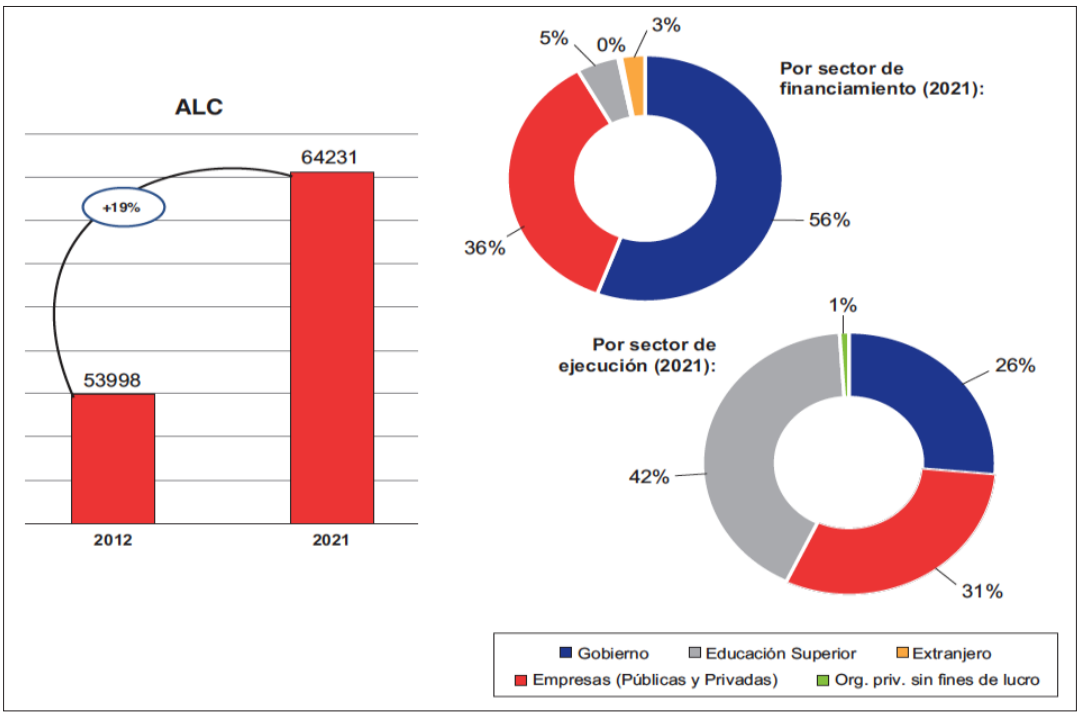


Figure 4: Sectorial Distribution of R+D Investment in Latin America and the Caribbean
Source: RICYT database; www.ricyt.org

LAC rise from almost 54 million in 2012 to more than 64.2 billion in 2021.

The weight of the government sector in the financing of R+D is greater than that of Ibero-America, representing 56% of the total invested.

On the other hand, the participation of companies is lower, responsible for 36% of R+D financing.

This is a distinguishing feature of the countries of the region compared to more developed countries, where investment by the corporate sector exceeds that of the government.

In terms of the resource execution sector, higher education institutions account for 42 per cent, the government sector for 26 per cent and enterprises for 31 per cent.

If we compare the R+D investment percentage evolution in LAC with the international context, we see that performs the highest relative growth until 2015, but then it is surpassed by the strong development experienced by Asian countries followed by Europe (Figure 5).

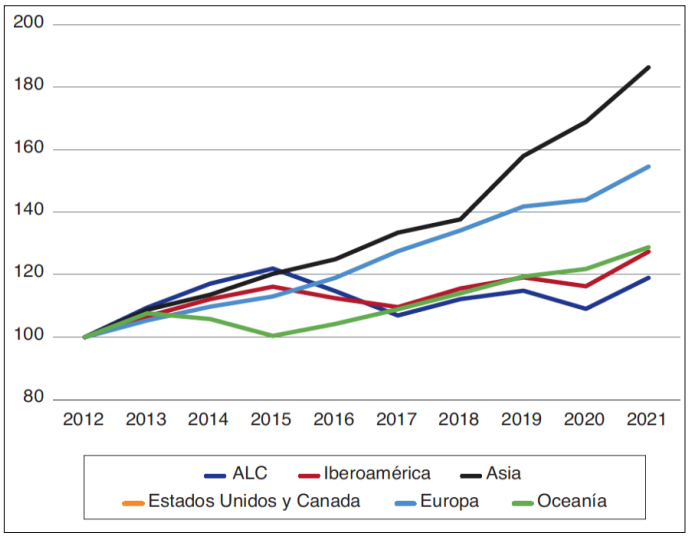


Figure 5: Percentage Evolution of Investment in R+D in Selected Geographical Blocks (PPP Dollars)
Source: RICYT database; www.ricyt.org

It is interesting to note most of the geographical blocks represented here managed to exceed the investment levels of 2019, although LAC shows a somewhat more moderate recovery.

In 2021, investment in R+D in LAC countries as a whole represented 2.32% of the total amount invested in the world, while Ibero-America accounted for 3.6%, in both cases maintaining a contraction trend in the decade under analysis (Figure 6).

Asia performs the largest investment in R+D, representing 41.6% of the world's investment, and has succeeded in the increasing participation in the last ten years.

It is followed by the United States and Canada, which in 2021 accounted for 30.5%, and the countries of the European Union, which accounted for 23.8%.

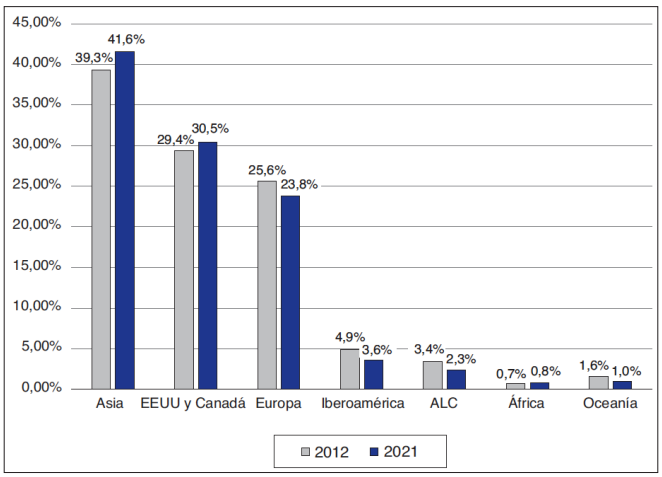


Figure 6: Distribution of Global Investment in R+D by Geographical Regions (PPP Dollars) Years 2012 and 2021 [8].
Source: RICYT database; www.ricyt.org

The countries with the highest investment in R+D in Ibero-America show a very different evolution in the last ten years (Figure 7).

Brazil increased its investment until 2015, showing a sharp decline until 2018, the year in which it began to recover until a marked drop in 2020.

Spain shows some stability in its level of investment until 2016 and then began a period of remarkable growth until the end of the series, reaching more than 27.5 million PPP dollars in 2021.

Mexico shows a negative trend from 2016 onwards that it failed to reverse in the rest of the series.

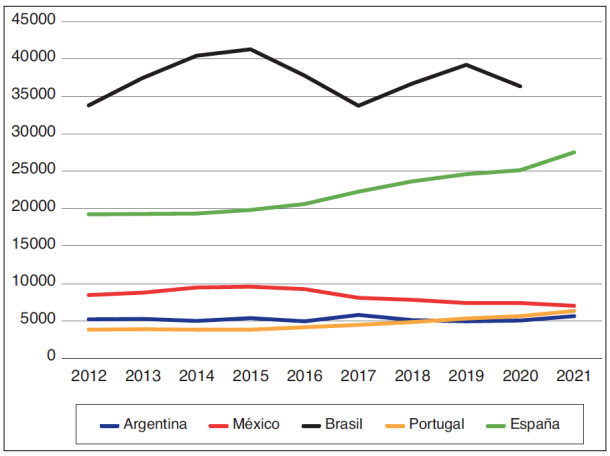


Figure 7: Investment in R+D in Selected Countries (Millions of PPP Dollars)
Source: RICYT database; www.ricyt.org

Argentina experienced a fluctuating evolution until 2017, when it contracted until 2020 when it managed to reverse the trend and end the period with a growth of 8% compared to 2012.

Finally, Portugal shows a relatively stable evolution until 2016, after which it begins to increase its investment volume, ending the series with a value 66% higher than in 2012.

Colombia shows a very strong increase in its investment in R+D until 2015, then shows a fall for three years, manages to recover part of its level of investment in 2018, but then falls again until 2020, without recovering pre-pandemic investment values in 2021.

Chile exhibits a sustained growth until 2018, the year in which it begins to reduce its investment.

Uruguay and Peru showed constant growth until 2018 and 2019, respectively.

In 2021, Peru continued with a negative trend while Uruguay managed to surpass its 2019 level of investment.

Differences can also be seen in LAC countries with a lower volume of investment (Figure 8).

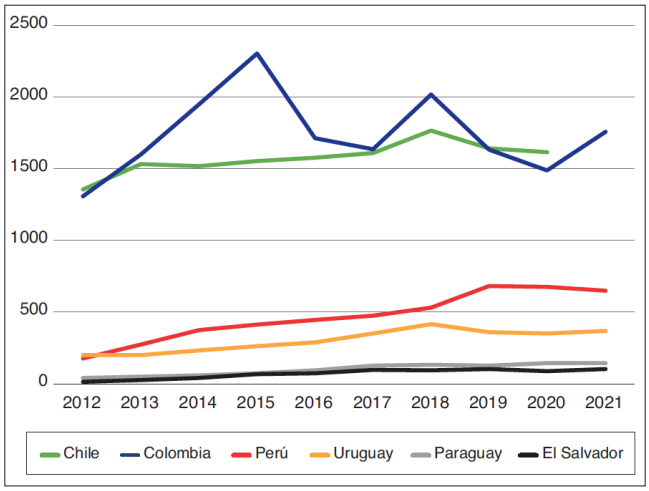


Figure 8: R+D Investment in Selected Countries (Millions of Dollars PPP)
Source: RICYT database; www.ricyt.org

Finally, El Salvador and Paraguay show similar levels of investment, both with a positive evolution until 2017 and then a slowdown in recent years.

One of the distinctive features of LAC is the strong concentration of investment in R+D in a few countries: Brazil alone represents 62% of the regional effort, while Mexico accounts for 13% and Argentina for 9% (Figure 9).

Colombia and Chile account for 3% of regional investment.

Although this concentration is somewhat related when comparing the size of their economies, the gap between these countries and the rest of Latin America in terms of investment in R+D is even more significant.

R+D investment by Ibero-American countries accounted for 0.77% of the region's gross product in 2021, while the same indicator for LAC reached 0.61% (Figure 10).

Spain, on the other hand, allocated 1.45% of its GDP and Brazil 1.16%.

Investment in the rest of the Latin American countries did not exceed the regional average in their R+D efforts.

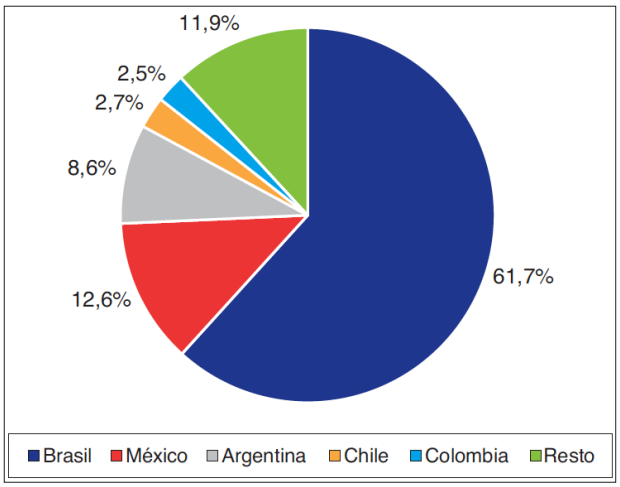


Figure 9: Distribution of LAC R+D Investment in 2020 (PPP Dollars)
Source: RICYT database; www.ricyt.org

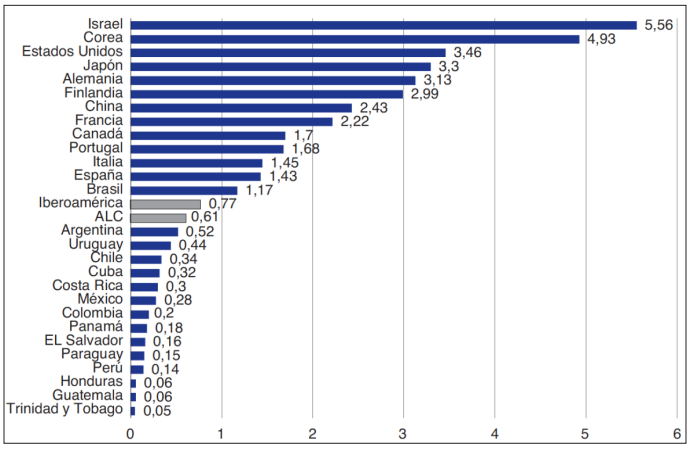


Figure 10: R+D Investment in Relation to GDP in Selected Countries and Regions Year 2021 or Last Year Available
Source: RICYT database; www.ricyt.org

Comparatively, investment by LAC and Ibero-American countries continues to be lower than investment by industrialized countries.

Portugal is the Ibero-American country that makes the most comparative effort in R+D, investing 1.68% of its GDP in these activities.

Israel is the country with the highest level of investment, allocating 5.56% of its GDP to R+D activities.

It is followed by Korea with an investment of close to 5% and then the United States, Japan, Germany, and Finland located at around 3% of their GDP.

The number of full-time equivalent (FTE) researchers in Ibero-America has grown by 45% between 2012 and 2021, from 436,521 to 634,421 (Figure 11).

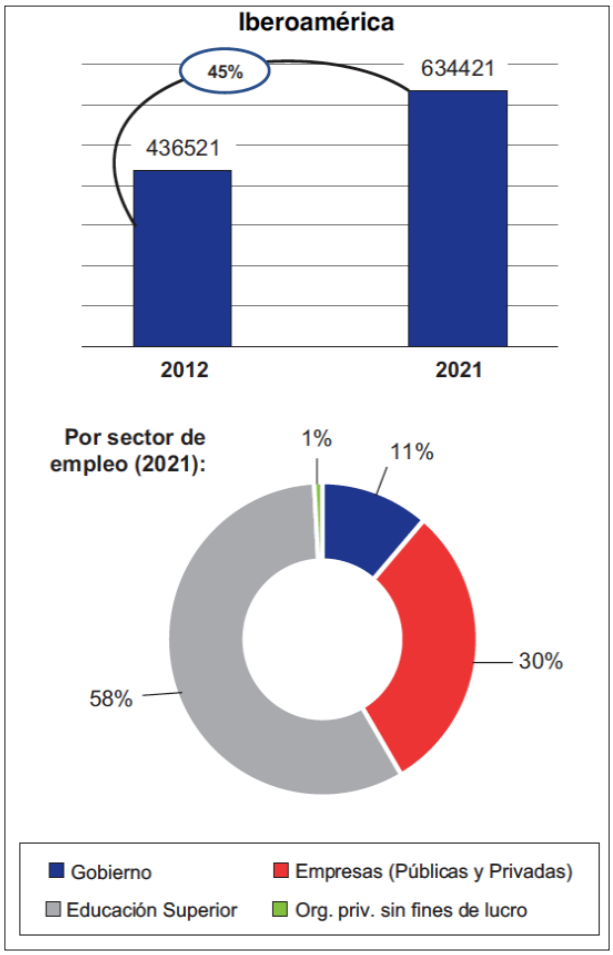


Figure 11: Researchers (FTEs) in Ibero-America
Total Values and Distribution by Employment Sector
Source: RICYT database; www.ricyt.org

The number of researchers is expressed in FTEs, a measure that simplifies international comparison since it is the sum of the partial dedications to R+D carried out by researchers during the year.

It refers to the time dedicated to research, and it is of particular importance, in science and technology systems in which the university sector has a preponderant presence, as is the case of Latin American countries, where researchers distribute their time with other activities such as teaching or transferring.

If we consider the human resources distribution according to the sector where they carry out their tasks, we see that the higher education sector is the most significant, since in 2021 58% of researchers carried out their activities at the university level.

30% of researchers in the region worked in companies (both public and private) and 11% worked in R+D institutions belonging to the public sector.

Like the financial resources allocated to R+D activities, Asian countries perform the highest representation of human resources allocated to research.

The Asian participation has grown over the last ten years (Figure 12).

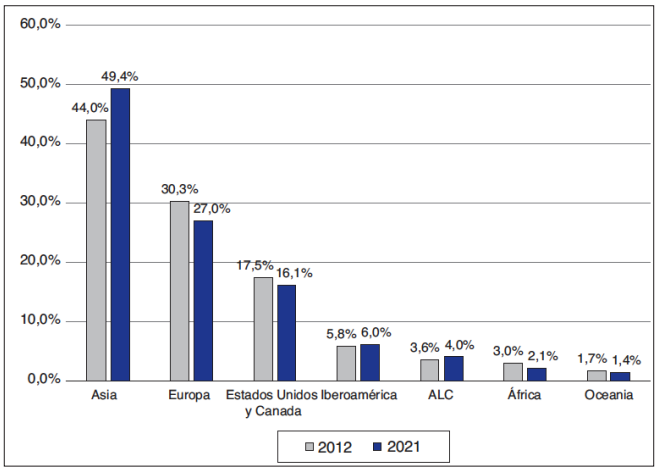


Figure 12: Distribution of Researchers (FTEs) by Geographical Blocks
Source: RICYT database; www.ricyt.org

In second place are researchers from the countries of the European Union, followed by Canada and the United States.

Ibero-American researchers (FTEs) accounted for 6.0% of the global total in 2021, surpassing the regional share of investment.

During the period 2010-2019, the relative weight of Ibero-America remained almost constant.

LAC's weight was 4% in 2021, a slightly higher share compared to 2012 and investment in terms of financial resources.

If the number of researchers (FTEs) in each Ibero-American country is analyzed, a similar picture is obtained to that indicated for R+D spending, with a very unequal distribution of resources between countries (Figure 13).

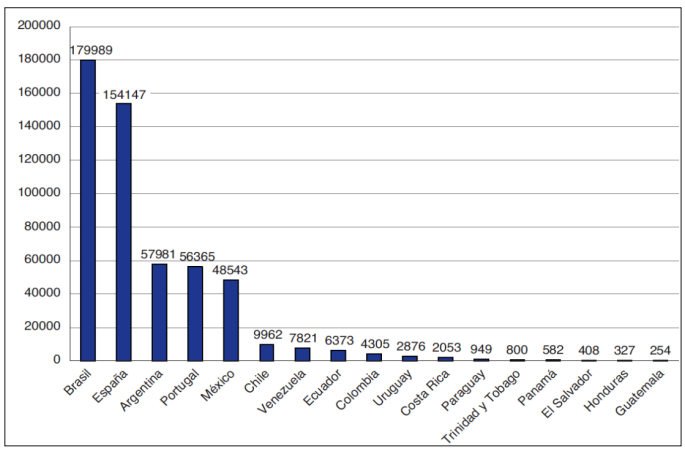


Figure 13: Number of Researchers (FTEs) in Selected Countries
Year 2021 or Last Year Available
Source: RICYT database; www.ricyt.org

Brazil and Spain have the largest number of researchers.

Brazil, the country had 173,830 researchers in 2017, surpassing Spain's 154,147 in 2021 and more than triple that of the next Latin American country: Argentina, with 57,981 researchers.

This is followed by Portugal, with 56,365 researchers, and Mexico with 48,543.

On a smaller scale, they are followed by Chile, Venezuela, Ecuador, and Colombia.

It is interesting to analyze the participation of women in relation to the total number of people engaged in research tasks, researchers, and fellows (Figure 14).

In 2021, the number of women working as researchers is less than 50% in most countries in the region, although reflecting gender gaps of different magnitude.

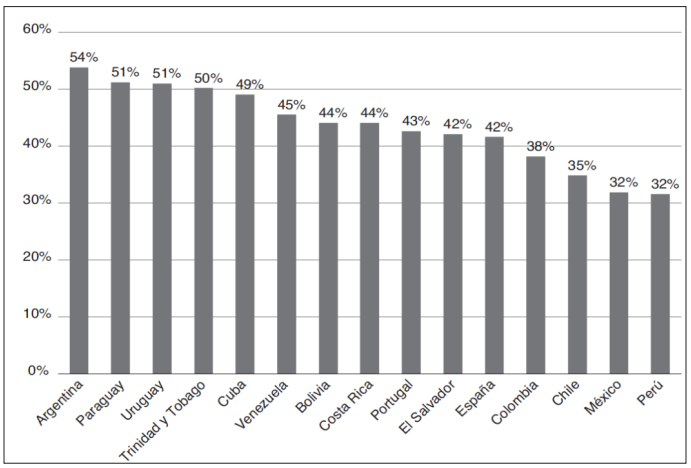


Figure 14: Percentage of Women Researchers and/or Fellows in Selected Countries Year 2021 or Latest Available Data
Source: RICYT database; www.ricyt.org

In Chile, Mexico and Peru, women account for only a third of researchers.

In Argentina, Paraguay and Uruguay, women represent more than a half of the people dedicated to research.

The Figure 15 shows the Ibero-American countries represented according to three variables that summarize the financial and human resources dedicated to R+D (Figure 15).

The size of the bubble is proportional to the investment in R+D made by each country, and these are placed according to the values adopted by the GDP investment on the horizontal axis and the number of FTE researchers per thousand members of the economically active population (EAP) on the vertical axis.

The countries best positioned according to these analysis variables (i.e. those closest to the upper right quadrant) are Portugal, Spain and, to a lesser extent, Brazil.

The number of researchers in relation to the EAP in Brazil and Mexico is lower than that of some countries with relatively smaller economies.

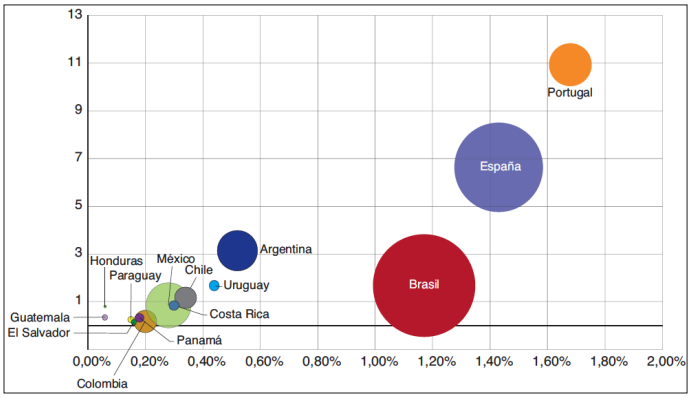


Figure 15: Ibero-American Countries Positioning Map to Resources Dedicated to R+D
Source: RICYT database; www.ricyt.org

The Argentine situation is reversed, with a significant number of researchers and relatively low investment.

In addition, the largest number of countries have values of less than 0.5% of investment in R+D in relation to GDP, and with one FTE researcher for every thousand members of the EAP.

Chile and Colombia stand out for resources they allocate to R+D and, with much smaller investment volumes, Ecuador, Uruguay, and Costa Rica.

According to INDICES Network data (redindices.org), the total number of Ibero-American higher education students went from 25.7 million in 2012 to 33.6 million in 2021, with a growth rate of 31% (Figure 16).

If we analyze its composition according to the levels of the International Standard Classification of Education (ISCED), we observe 82% of students in 2021 correspond to level 6 (bachelor's degree), followed by level 5 (non-university tertiary) with 10% and level 7 (master's) and 8 (doctorate) with 6.5% and 1.2% respectively (Figure 17).

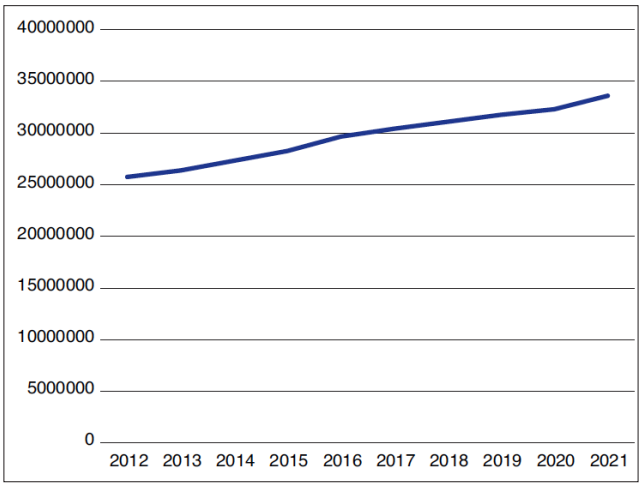


Figure 16: Evolution of the Number of Students in Higher Education in Ibero-America
Source: RICYT database; www.ricyt.org

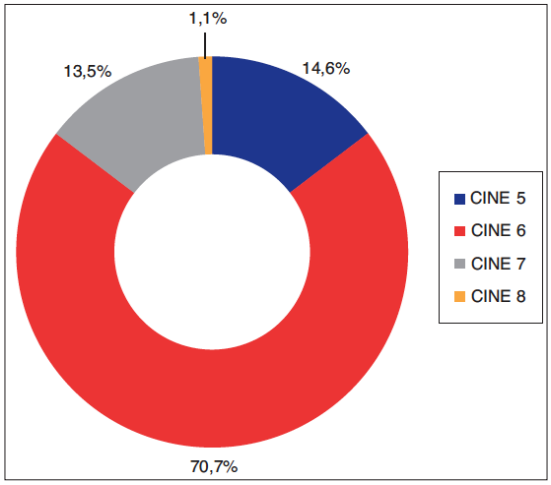


Figure 17: Evolution of the Number of Higher Education Graduates in Ibero-America and Distribution by ISCED Level [9].
Source: RICYT database; www.ricyt.org

The total number of graduates in Ibero-America has also grown significantly, going from almost 36 million in 2012 to over 4.9 million in 2021 after a drop experienced in 2020, a year marked by the pandemic.

Regarding the distribution by ISCED level, level 6 (bachelor's degree) predominates with 71%, followed by level 5 (non-university tertiary) and 7 (master's degrees) graduates, with 14.6% and 13.5% respectively.

The later data is coincident with the percentage participation of students, level 8 (doctorate) graduates accounted for 1% of the total.

In the years covered by this series, the number of articles published in scientific journals registered in Scopus grew by 44% (Figure 18).

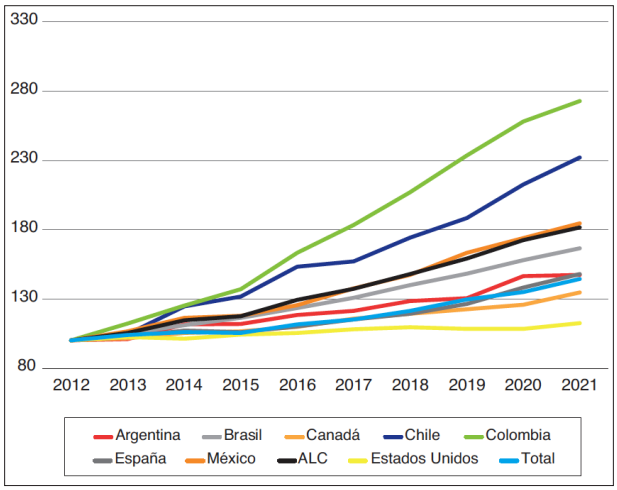


Figure 18: Evolution of Publications in Scopus (%)
Source: RICYT database; www.ricyt.org

The number of articles signed by LAC authors grew at a faster rate than the total base, reaching an 82% higher volume in 2021 compared to the beginning of the series.

Within the region, the growth of Colombia and Chile stands out, tripling and doubling, respectively, the number of publications in the database.

The United States, the world leader based on the volume of its scientific production, shows a stable and sustained evolution over time with a 13% growth.

With great ups and downs, the number of international patents applied for through the Patent Cooperation Treaty (PCT) shows a drop in 2021 compared to 2012 for Ibero-America and LAC of 12% and 19%, respectively (Figure 19).

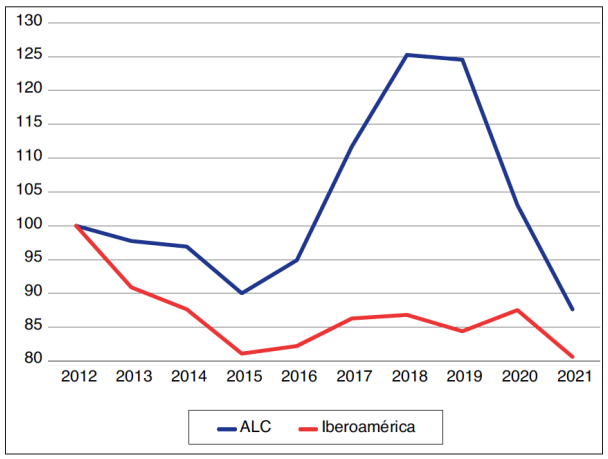


Figure 19: Percentage Evolution of the Number of PCT Patent Applications
Source: RICYT database; www.ricyt.org

In both cases, but especially for Latin American countries as a whole, there was a sharp drop in the number of patent applications during 2021 [10].

The drop-in patent applications from Spain, Mexico and Brazil had an impact on the fall in the Ibero-American total.

It is worth mentioning Portugal and Chile, two countries that showed an opposite trend, with growth of 90% and 55% respectively during the decade.

Turning now to patents applied for in the intellectual property offices of the countries of the region, 83% in 2021 of patent applications in LAC countries correspond to non-residents, mainly to foreign companies protecting products in the region's markets (Figure 20).

Figure 21 presents a summary of different indicators related to innovation and competitiveness in several countries around the world, with a general poor performance of Guatemala in key aspects for our economic and social development [11-13].

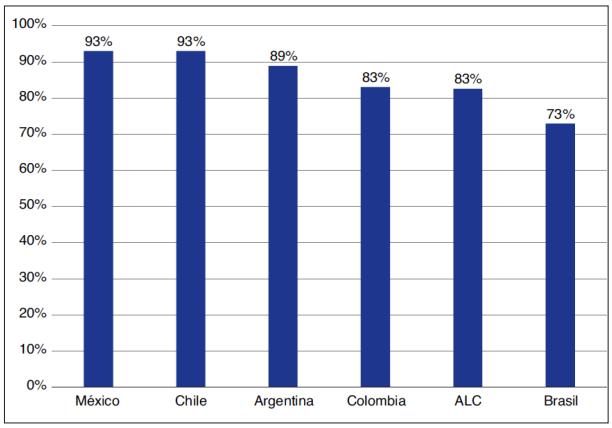


Figure 20: Patent Applications by Non-Residents Regarding the Total Number of Applications in Selected Countries
Source: RICYT database; www.ricyt.org

Country	Global Competitiveness Index 2018		Economy of Knowledge (KEI) 2018		GDP per cápita Nominal (in current USD) 2019		Tertiary Education Matriculation rate 2016		Global Human Capital Index 2018		% of Internet Users 2016		Human Developement Index (HDI) 2018	
	Ranking	Note	Ranking	Note	Ranking	USD	Ranking	Note	Ranking	Note	Ranking	%	Ranking	Value
USA	1	85.6	13	8.77	8	65,062	9	28.17	4	74.84	55	76.18	13	0.924
Germany	3	82.8	8	8.9	18	49,692	18	23.72	6	74.30	22	89.65	5	0.936
Japan	5	82.5	22	8.28	26	41,418	9	34.40	17	72.05	17	92.00	19	0.909
Hong Kong	7	82.3	18	8.52	17	50,567	SD	SD	SD	SD	27	87.30	7	0.933
Finland	11	80.3	2	9.33	16	50,879	3	34.79	2	77.07	26	87.70	15	0.920
Sweden	9	81.7	1	9.43	12	54,135	14	24.93	8	73.95	18	91.51	7	0.933
UK	8	82.0	14	8.76	23	42,036	13	25.89	23	71.31	12	94.78	14	0.922
Norway	16	78.2	5	9.11	4	82,773	9	28.19	1	77.12	8	97.30	1	0.953
Denmark	10	80.6	3	9.16	9	62,984	12	26.08	5	74.40	9	96.97	11	0.929
Canada	12	79.9	7	8.92	19	48,601	1	38.14	14	73.06	21	89.84	12	0.926
Qatar	30	71.0	54	5.84	7	72,677	59	12.22	55	63.97	14	94.29	37	0.856
Taiwan	13	79.3	13	8.77	38	26,518	ND	ND	ND	ND	42	79.75	ND	ND
New Zeland	18	77.5	6	8.97	24	42,009	9	28.71	7	74.14	24	88.47	16	0.917
Australia	14	78.9	9	8.88	11	57,204	11	26.94	20	71.56	25	88.24	3	0.939
Korea, Rep	15	78.8	29	7.97	30	32,766	24	25.26	27	69.88	16	92.72	22	0.903
Costa Rica	55	52.1	51	5.93	65	12,567	38	18.09	61	62.38	81	66.03	63	0.794
Mexico	46	64.6	72	5.07	73	9,866	56	12.92	69	61.25	92	59.54	74	0.774
Guatemala	96	53.4	99	3.7	108	4,699	93	6.41	100	55.83	134	34.51	127	0.650
	Countries	137	Countries	145	Countries	179	Countries	130	Countries	130	Countries	228	Countries	188

Figure 21: Innovation and Competitiveness Indicators
Source: Authors

Conclusions

Specifically, the framework in which Science, Technology and Innovation is developed in LAC is summarized as follows:

- ✓ Lack of economic growth and loss of competitiveness.
- ✓ Insufficient scientific and technological capacity.
- ✓ Insufficient, inadequate, and inconsistent funding.
- ✓ Low number of researchers and quality postgraduate programs.
- ✓ Limited and disjointed infrastructure.
- ✓ Lack of innovation and low productivity.
- ✓ Weak partnerships.
- ✓ Inadequate legal framework that is not contributing to Science, Technology, and Innovation.
- ✓ Absence of a long-term vision and public policies.
- ✓ Neglect of opportunities and strategic areas of knowledge.
- ✓ Weak institutions.

Today, it is impossible to ignore that technological development and innovation are two vital forces driving social development and the growth of the global economy.

Even more so, in the context of the Knowledge Society, driven by the revolution of Information and Communication Technologies, in which new technologies are changing the way we interact daily, the mode we deliver public services to citizens and the way we do business.

However, in LAC most indicators show a lag in terms of Science, Technology, and Innovation.

This is due to several factors, including the fact that a large part of companies has not yet place technology and innovation at the center of their competitive strategy.

Besides the governments still face obstacles in translating good intentions into coherent public policy frameworks with a sustained allocation of resources or in a greater sophistication of their strategies to promote Science, Technology, and Innovation.

The urgency of reducing poverty and inequality or improving the country's infrastructure, for example, which require significant investments, seems to place Science, Technology, and Innovation as a luxury.

To move forward, it is necessary:

- To communicate and make young people understandable recent scientific and technological advances,
- Highlight the importance of generating knowledge through scientific research, its application via creation and transfer of technology,
- The promotion of entrepreneurship and innovation processes as a mechanism to lead our creativity from "the idea to the market".
- The emphasis that, "Building our scientific culture, based on a scientifically educated youth with values", are the differentiating elements that will lead us towards the consolidation of a better society.

To this end, it is key to permeate the perception in the LAC societies, mainly among young people, that the impulse, investment and synergistic development of Education, Science, Technology, and Innovation is, without any doubt, the common thread of our path to prosperity.

This challenge, however, must be faced with a long-term and in-depth regional strategic vision, strengthening the cultural ties that connect us, we can no longer afford to work in isolation, alone and with an endogamous thinking and attitude.

Linking science and technology institutions with social demands involves a process that mobilizes not only the scientific community, but also many other actors in social life.

The operationalization of the National Strategic Plans for Scientific and Technological Development, as the instrument of the National Policies for Scientific and Technological Development, is the key to promote LAC sustainable development, equity, and social cohesion.

The task of facing Education, Science, Technology, and Innovation challenges is complex and cannot be delegated; The Knowledge Society opens up new scenarios for us, in which we cannot afford to consume second-hand science and technology, it is time to start assuming our leading role, to build our own destiny, and it will be through education, science and culture, the most suitable path.

Let's all make the dream come true that "disruptive technologies applied to health, transportation, the food industry, the prevention of natural disasters and the effects of climate change, will be a reality in our country".

We are convinced that we will soon transcend the words of Isaac Asimov who in 1949 stated, "The saddest aspect of life today is that science gains in knowledge more rapidly than society in wisdom".

We want to close this article full of hope and optimism, with the phrase of Eleanor Roosevelt who in the 40´s said: "The future belongs to those who believe in the beauty of their dreams".

References

1. Lemarchand G (2017) Editor. Survey of Research and Innovation in the Republic of Guatemala. 2017. UNESCO/ Go-SPIN. 269 pp. https://unesdoc.unesco.org/ark:/48223/pf0000248067.
2. UNESCO Science Report (2021) the race against time for smarter development. 2021. United Nations Educational. https://www.unesco.org/reports/science/2021/en/report-series.
3. World Bank Annual Report (2023) A New Era in Development. 2023. Washington, DC. World Bank. https://www.worldbank.org/en/about/annual-report.
4. Digital Agenda for Latin America and the Caribbean (eLAC 2024). 2023. https://www.cepal.org/es/proyectos/agenda-digital-america-latina-caribe-elac2024.
5. Albornoz M, López-Cerezo J (2021) Science, Technology and the University in Latin America. 2021. Educational Goals 2021, Organization of Ibero-American States. Eudeba Editorial, Buenos Aires, Argentina, 216 pp. https://oei.int/downloads/.
6. The State of Science (2022) 2023. Network of Science and Technology Indicators, Organization of Ibero-American States, Buenos Aires, Argentina. https://www.ricyt.org/2022/11.
7. Technological Revolution and Social Inclusion: Reflections on Challenges and Opportunities for Social Policy in Latin America. 2020. CEPAL. https://repositorio.cepal.org/items/23a60b3f-3783-48e8-9528-4dd16a0e28bc.
8. Global R&D Funding Forecast (2022) 2023. Industrial Research Institute. https://forecast.rdworldonline.com/.
9. Tünnermann C (2023) Dominant Trends in Contemporary Higher Education. La Prensa. https://www.laprensani.com/2023/07/08/opinion/3172274-tendencias-dominantes-en-la-educacion-superior-contemporanea.
10. Latin American Economic Outlook (2020) Digital Transformation for Building Back Better. Digital transformation for an inclusive and sustainable post-Covid-19 recovery. 2020. CEPAL. https://www.oecd-ilibrary.org/sites/b499116c-es/index.html?itemId=/content/component/b499116c-es.
11. Schuab K, Zahidi S (2020) The Global Competitiveness Report 2020; Special Edition. How Countries are Performing on the Road to Recovery. World Economic Forum 95. https://www.weforum.org/publications/the-global-competitiveness-report-2020/.
12. Dutta S, Lanvin B, Rivera León L, Wunsch-Vincent (2023) Editors. 16th Ed. Global Innovation Index 2023; Innovation in the face of uncertainty. World Intellectual Property Organization, Switzerland 253. https://www.wipo.int/global_innovation_index/en/2023.

13. The Fiscal Panorama of Latin America and the Caribbean (2023) fiscal policy for growth, redistribution, and productive transformation. 2023. NU-CEPAL 146. https://www.cepal.org/en/publications/48900-fiscal-panorama-latin-america-and-caribbean-2023-fiscal-policy-growth.