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VENTURE CAPITAL FOR BIO-ENTREPRENEURSHIP AND REGIONAL INTEGRATION: AN OPPORTUNITY FOR A NEW SYMBIOSIS

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This article discusses the opportunity of regional integration through the bioeconomy in Latin America to promote the development of bioentrepreneurship by attracting venture capital. In this sense, it highlights the importance of bioeconomy as an avenue for productive diversification. However, it also highlights the challenges faced by bio-entrepreneurs such as the lack of an enabling environment, the informality of business and the difficulty of accessing finance. The article shows the importance of venture capital as a source of support for the development of bio-entrepreneurship and mentions the need for public institutions to foster its growth. It concludes that regional integration in the bioeconomy can be an opportunity to attract venture capital and strengthen the development of bioentrepreneurship.

Keywords: *Bioeconomy, regional integration, bio-entrepreneurship, Latin America, Venture Capital.*

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VENTURE CAPITAL PARA BIOEMPRENDIMIENTOS E INTEGRACIÓN REGIONAL: OPORTUNIDAD PARA UNA NUEVA SIMBIOSIS

Este artículo analiza la oportunidad de la integración regional a través de la bioeconomía en América Latina para promover el desarrollo del bioemprendimiento mediante la atracción de capital de riesgo. Destaca la importancia de la bioeconomía como vía de diversificación productiva y muestra los desafíos que enfrentan los bioemprendimientos, como la falta de un entorno propicio, informalidad de los negocios y dificultad de acceder a financiamiento. El artículo muestra la importancia del capital riesgo como fuente de apoyo para el desarrollo del bioemprendimiento y menciona la necesidad de que las instituciones públicas fomenten su crecimiento. Se concluye que la integración regional en la bioeconomía puede ser una oportunidad para atraer capital de riesgo y fortalecer el desarrollo del bioemprendimiento.

Palabras clave: *Bioeconomía, integración regional, bioemprendimiento, América Latina, Venture Capital*.

Introduction

The bioeconomy has enabled the creation of business initiatives aimed at economic growth through biodiversity as a pathway to sustainable productive diversification. These initiatives are characterized by bioenterprise ideas, projects and innovations that have a high potential for positive environmental, political, technological, and socio-economic impact on countries if they reach the enterprise stage.

Bioenterprises tend to be more complex than other areas of entrepreneurship because the use of biological resources requires periods of technical validation, the use of the equipment and specialized personnel, which increases the level of initial investment. As a result, the development of bioenterprises in Latin America has been hampered by a lack of favorable conditions for attracting investment.

The disarticulation of the ecosystem, the regionalisation of bio-economic innovation initiatives and the lack of institutions in this field have made it difficult to attract this capital. However, each Latin American country has relevant strengths compared to its peers and even to countries in other regions. Some of these strengths are: 1) highly qualified human resources; 2) competitive innovations in science and technology; 3) raw materials for the development of the bioeconomy.

As these elements are scattered throughout the region, each country has the opportunity to strengthen its weaknesses by learning from its neighbors. In this sense, this article aims to show how Latin America's integration into the bioeconomy can attract venture capital if it succeeds in creating an institutional framework in this area that promotes the development of bioeconomy through its business units, the bioenterprises.

The theoretical postulates guiding the research correspond to regional integration, with an emphasis on new regionalisms and the bioeconomy as sustainable an alternative development model. On the other hand, a comparative analysis of the following indices was used to define the potential and opportunities for improvement of bio-enterprises in the region: Global Innovation Index Score (2021), R&D investment as a percentage of Gross Domestic Product (GDP) and the Economic Complexity Index (2020). It is expected to generate new debates that promote the integration of Latin America, harnessing the region's potential and strengthening the institutional framework for the bioeconomy.

1. A new approach to regional integration

Current regional integration is grounded in the concept of new regionalism, an approach that emerged in the 1990s, characterized by its focus on trade liberalization and global market competitiveness, in alignment with 21st-century trade policies.

This model prioritizes free trade agreements and economic openness; however, one of the main criticisms lies in its limited attention to sustainability and social cohesion. (Perrotta, 2010; Warleigh-Lack, 2006; Quiliconi & Espinoza, 2017).

In this context, proposing a regional integration model based on bioeconomy can address these shortcomings of new regionalism, as the concept of bioeconomy not only promotes sustainable development but also encourages the decentralization of employment, reducing disparities between the center and the periphery through the intensive and responsible use of biological resources. (Acetta; Gonzalez De Cap; Brenes Porras & Chavarría, 2022; Brenes Porras; Napsuciale Heredia; Jimenez Rodriguez, & Chavarría Zamora (2024).

The concept of the bioeconomy refers to the intensive use of knowledge of biological resources, processes, technologies, and principles to achieve sustainable production of goods and services in all economic sectors (IICA, 2018). Its potential has led to the emergence of business initiatives that focus on economic growth through the valorization of biodiversity, providing an avenue for productive diversification. These initiatives are characterized by their impact on the international agenda, due to their relationship with the United Nations (UN) Sustainable Development Goals (SDGs). (FAO, 2019).

This premise also diverges from old regionalism, as it sought integration as a path toward emancipation. Moreover, it promoted integration not only on an economic level but also politically and socially, aiming for regional autonomy in the face of external influences. (Väyrynen, 2003; Fawcett, 2004; Caetano & Sanahuja, 2019).

Meanwhile, this article focuses on integration from the perspective of the economic model, specifically through the development of bioeconomy enterprises, known as bioenterprises.

Therefore, bioentrepreneurship refers to any biological science applied to real-world problems with a connection to commercial enterprise. It includes a variety of bioeconomy's topics, ranging from biomedical research to crop science (Fisher, Axup, Danie, Hess & Lonnen, 2022), and has been on the rise in recent years, with the number of Latin American bio-based companies in industries such as agrotechnology doubling and currently reaching more than 1600 across the region (Petignat, 2022).

The food, agriculture, and healthcare sectors are expected to be the main trends in Latin American bio-enterprise, strongly driven by biotechnology and digital transformation solutions. These trends or "verticals" in bioentrepreneurship are consolidated based on the volume of start-ups that manage to reach a valuation[4]

[4] Value a company has in an established period of time. There are pre-valuation and post-valuation models.

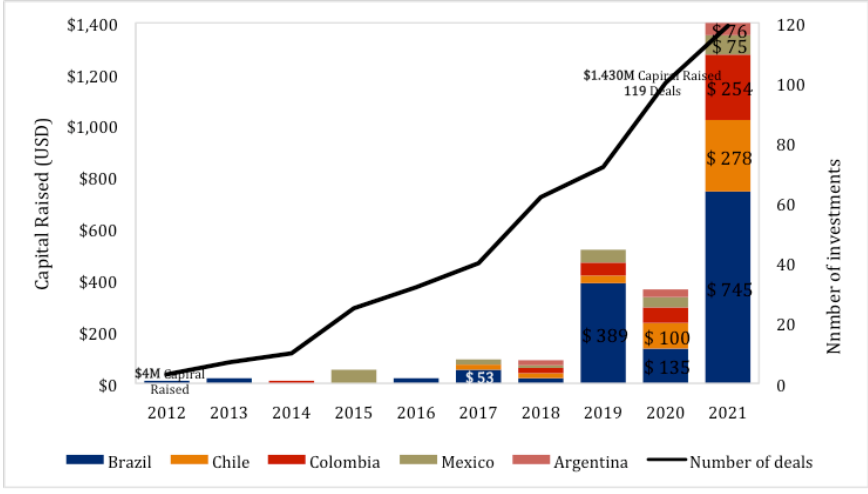
of at least $100 million in less than ten years of operation. The visibility and performance of bioentrepreneurs in these verticals incentivizes capital attraction, technology adoption and growth in these sectors (Endeavor, 2021).

Countries such as Mexico, Brazil, Chile, and Argentina have positioned themselves as leaders in the creation of bioenterprise in the region, in many cases providing the infrastructure, training, and availability of capital necessary to consolidate the first steps of a new entrepreneurship.

In 2021 alone, bioeconomy verticals will attract at least $1.43 billion in venture capital investment (Figure 1), with Brazil accounting for 52%, Chile 19%, Colombia 18%, Mexico 5%, and Argentina 5% of the total capital (Endeavor, 2021). However, there are specific challenges that need to be addressed in order to create the right conditions for the development of bioenterprises.

Figure 1.

Venture Capital investment in Latin American bio-enterprises



Fuente: *Endeavor, (2021).*

Bioenterprises, especially technology-based ones, face challenges related to the time-consuming nature of developing the right technology or innovation, the need for technical validation requiring specialized infrastructure, and the high risk associated with putting the idea into practice. Despite this, their proliferation continues due to the hope of future profitability and their large impact on the climate crisis (Blank, 2020).

In addition to the peculiarities of this activity, the regional context faces some challenges of its own, such as the informality of the economy, the excessive

bureaucracy required to formalize a business, the difficulty of accessing non-traditional capital or sources of financing, and the disharmony of regulatory and normative processes (Pianese, 2023 & Álvarez, 2023). These elements not only hinder the consolidation of an idea, but also the internationalization of those bioenterprises that have managed to develop.

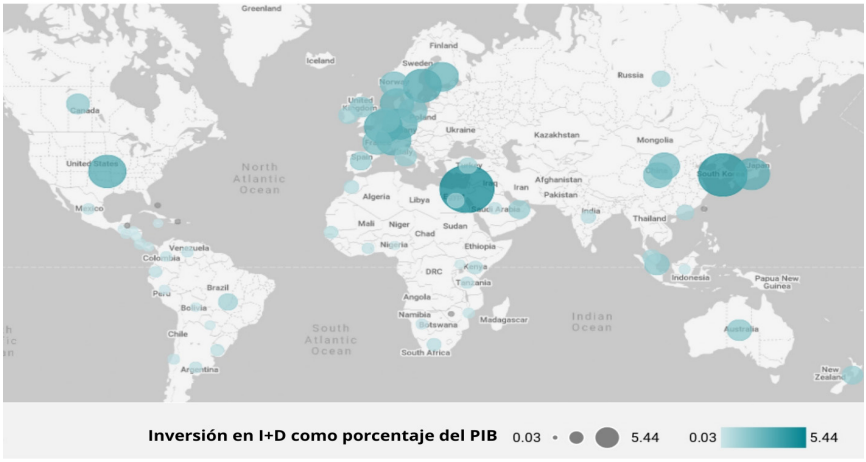
In turn, one of the major challenges for any product, input or even service from the bioeconomy is that, if there is legislation in place in both the country of origin and the country of destination, it will be possible to internationalize the product; otherwise it will become a technical barrier to trade, hindering the export process and affecting the growth of this type of business.

On the other hand, there are significant deficiencies in terms of investment by countries in this area. Latin American countries' investment in Research and Development (R&D) as a percentage of their GDP is significantly lower when compared to countries in different regions of the world as shown in Figure 2.

The only country in the Latin America and the Caribbean (LAC) region that has a percentage of investment in R&D greater than 1% with respect to its GDP is Brazil, with 1.21% according to figures from the World Bank (2021). The average investment in the region is 0.67%, a figure that is well below other regions, such as East Asia and the Pacific (2.63%), the European Union (2.32%), North America (3.32%), and the Middle East and North Africa (1.59%).

Figure 2.

Research and development (R&D) graph as a percentage of national GDP

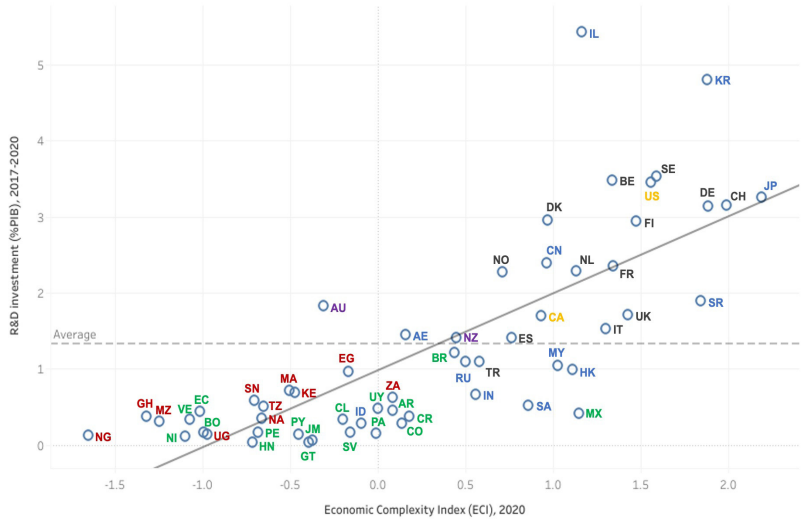


Source: World Bank (2021).

The Economic Complexity Index (ECI) can also be used to analyze the state of the region's economy. This indicator represents the diversity and complexity of a country's exports, which in turn are measured by national knowledge and production capacities. In other words, the ECI measures the diversity of products a country produces and assesses the degree of specialization required to produce them. As can be seen in Figure 3, the degree of sophistication of an economy can, of course, be related to the amount that countries spend on R&D.

Figure 3

Investment in research and development (R&D) as a percentage of national GDP VS national Economic Complexity Index (ECI).



Source: World Bank (2021) and Economic Complexity Observatory (2021).

Note: The corresponding names of the abbreviations shown in the figure can be found in Table 1 of the Annexes section.

Although the level of complexity of the LAC economy is generally low, and its share of R&D investment is lower than in other regions, it has great potential for developing its bioeconomy by adding value to raw materials. A key strategy for this is to promote the development of technology-based bio-enterprises.

However, during the formation of the welfare state, in the early years of the consolidation of most Latin American governments, these administrations allocated large budget amounts in order to support - as far as possible - innovation in their territories. However, with the passage of time, Beck (1998) indicates that there was a dissociation between the state and power, especially economic power, resulting in countries having less and less capacity to invest in the development of their societies.

Under this premise, in a multipolar world, the emergence of new private actors is taking center stage on the international scene (Schulz, 2017), which is where the importance of venture capital (VC) comes in. This capital is able to provide bioenterprises with the enabling conditions for their development. In this sense, there are VCs who oversee identifying ideas, validating their technology and, depending on the degree of innovation of this technology, providing economic and human support for its respective development (SF500, 2023).

VC support for bioenterprises has arisen because they have been characterized by their sustainable approach, their ability to address the major challenges of the 2030 agenda and their high return capacity - increased individual wealth (FONTAGRO, 2022). However, for this return capacity to materialize, the business must have the ability to scale up to other markets, as a niche bio-economic market in a single country may be limited.

VC and the other actors involved in fostering the development not only of bioenterprises, but also of any type of business unit, have not replaced the symbolic value of public institutions. For example, those institutions involved in R&D, which help initiatives in this direction to have a greater scope in terms of the impacted beneficiary population.

However, public investment for development has been steadily declining (Romero, 2002), so creating enabling spaces to attract private investment is a vital element for the development of bioeconomy ventures.

Regional bio-economic integration would allow the attraction of VC and the development of bio-enterprises, in the sense that by facilitating the development of the latter, it would facilitate the attraction of the former. Although there have been various regional and sub-regional integration initiatives in the past, such as the Pacific Alliance, the Andean Community (CAN), the Central American Integration System (SICA), the Caribbean Community (CARICOM), among others (Economic Commission for Latin America and the Caribbean, 2023). (ECLAC, 2023).

Although the topic of integration related to the latest bioeconomy technologies has been present in regional integration frameworks (such as the Andean Community and MERCOSUR) and international agreements (such as the Cartagena Protocol), these spaces were initially created as general cooperation structures. (Coates, 2007; Caetano & Sanahuja, 2019). However, in some of them, specific agreements and projects in biotechnology have been developed, such as:

- **Andean Community (CAN)**: The CAN has established a set of key decisions for biotechnology, such as Decision 345 on the protection of the rights of breeders of new plant varieties, and Decision 391 on access to genetic resources. These agreements aim to coordinate the use and access

to agricultural biotechnology and protect the region's biological resources and traditional knowledge. (Gómez Lee, 2012)

- **MERCOSUR**: MERCOSUR has created the Ad Hoc Group on Agricultural Biotechnology and launched projects like BIOTECSUR, a platform for cooperation in agricultural biotechnology. BIOTECSUR promotes collaboration in research and development projects between public and private stakeholders, focusing on value chains such as soybeans, beef, and bioenergy, which are strategic for member countries. (Corley, 2016)

- **Argentine Brazilian Biotechnology Center (CABBIO):** This is a joint effort between Argentina and Brazil, promoting research and training in biotechnology across various fields such as health, agriculture, and industry, facilitating exchanges and capacity development between the two countries. (Bisang, Campi, Cesa, 2009).

- **Cartagena Protocol on Biosafety**: Implemented at the subregional level in several member countries, this protocol regulates the transit and use of genetically modified organisms (GMOs) to ensure the protection of biodiversity and human health, thus establishing a shared biosafety framework among member states. (Burgiel, 2002).

Advancing a proposal for integration based on new regionalism, with a particular focus on bioeconomy, would enable businesses in this sector to find a solid regional demand to meet. This, in turn, would expand their market and position them as highly attractive options for venture capital. This type of integration requires taking into account considerations that have been successful in other regions, as indicated by Liu; Cui; Chen & Xiu, (2023) , among which the following stand out:

- **Elimination of Administrative Barriers:** By reducing bureaucracy and simplifying administrative procedures, companies can operate more efficiently and effectively across different regions. This has allowed businesses to expand beyond their original geographic boundaries, facilitating collaboration and resource exchange among them.

- **Strengthening Connectivity:** Investment in infrastructure, such as transportation and communication networks, has improved connectivity between cities and regions. This not only facilitates the movement of goods and services but also enables a freer flow of information and resources, which is essential for inter-business collaboration.

- **Encouraging Business Collaboration:** The creation of coordination frameworks and incentive policies has encouraged companies to work together on joint projects. This has led to the formation of industrial clusters where businesses can benefit from specialization and the division of labor, which in turn enhances regional competitiveness.

- **Exchange of Innovation and Knowledge:** The removal of local protections and the promotion of a competitive environment have enabled companies to share information and knowledge. This has strengthened the "peer" effect in innovation, where companies inspire each other and adopt best practices, resulting in increased innovation and efficiency.

- **Increase in Investment in Innovation:** With a more collaborative environment and fewer restrictions, companies are more willing to invest in research and development (R&D). Regional integration has created an ecosystem where businesses can access shared resources, reducing costs and risks associated with innovation.

- **Development of an Innovation Culture:** Promoting a business culture that values collaboration has led to a shift in the mindset of companies. This has fostered an environment where innovation is seen as a collective effort, resulting in an increase in innovative activity in the region.

- **Improvement of Regional Competitiveness:** As companies integrate and collaborate more, the region as a whole becomes more competitive. This not only benefits individual businesses but also attracts external investments and improves the region's position in the global supply chain.

- **Attraction of Regional Venture Capital:** By establishing a regionally constituted system, investors have greater opportunities to place their investments, promoting innovation and the development of businesses in the bioeconomy sector.

This type of integration, while aiming to promote trade openness to facilitate the development of the bioeconomy, relies on the creation of supranational institutions with clear and sustainable long-term objectives. To achieve this, a rotating presidency model could be adopted among member countries, with each country assuming the presidency for a previously established period. (Consejo de la Unión Europea, 2024).

However, there are many reasons why integration processes have not been able to consolidate, such as, for example, the lack of shared political efforts prioritizing

bilateral alliances that maintain traditional power and governance structures, little civil society participation, lack of resources and institutional capacities, among others (Aguilar-Antunes & Rodríguez Quesada, 2022; Duarte, 2018; Teubal, 1968). Therefore, it seems essential to find an economic model that adapts to the characteristics of the region. In this sense, the bioeconomy[5] has the facility to incorporate the features of diverse areas, but with high biological resources to be developed (Arias, 2021).

In this sense, starting with technology transfer processes, standardizing normative conceptualizations, creating institutions that promote and support the bioeconomy, as well as validating the research and phytosanitary processes required for bioeconomy production through impartial bodies agreed by all the states in the region, could be the first steps in the development of bioeconomy economic integration.

This does not necessarily mean creating new spaces for convergence, but rather taking advantage of existing mechanisms to revitalize them through this type of initiative.

It should be noted that it is essential to have public administrations that do not require political positions, as this will facilitate the continuity of visions without being interrupted by changes in government administrations. There must also be a direct relationship between the private sector and knowledge management centers or universities in order to achieve real bio-economic development (European Commission, 2020).

At the same time, the bioeconomy must continue to defend its territorial approach to promote its technologies and innovation. An element that, according to Teubal (1968), hinders any integration strategy because of the region's high external dependence on other countries for R&D.

However, this type of integration, with both national and regional institutions working together on the issue, would facilitate technical cooperation on issues such as knowledge and technology transfer, coordinated industrial policies in the bioeconomy and established protocols for the export of agricultural products, which would allow to explore the possibility of reducing some type of tariff barrier. This would inevitably have a positive impact on the internationalization of bio-enterprises.

The sum of these elements would create conditions for the attraction of VCs for bioenterprises, which would imply greater investment to boost those business units coming from the bioeconomy. This would have a direct impact on greater

[5] There is no single way to develop the bioeconomy, as the production chains and available biomass vary from country to country. However, it is agreed with the elements incorporated in the definition of bioeconomy from this document.

employment opportunities, including in peripheral areas (Biointropic, 2018). This would also indicate that through integration, the development of member countries increases (Konrad Adenauer Foundation, 2011, Trubal, 1968, Duarte, 2018).

Indeed, regional integration of this kind implies state intervention, not necessarily in terms of investment in R&D, but it needs to make available part of its institutional framework and human talent to facilitate the inter-institutional framework that favors the attraction of external investment, i.e. VCs.

One of the major challenges that this integration will face is twofold: 1) the knowledge of the country, and of course of civil society, about the bioeconomy and the opportunities it offers, 2) as well as the lack of a consolidated investment culture (Romero, 2002).

Conclusions

Bioeconomy has spurred the creation of business initiatives focused on economic growth through biodiversity, offering opportunities for productive diversification and a new form of economic development. However, the exploration of this alternative in the region may result in the transformation of Latin America's natural comparative advantages into competitive advantages, leading to an increase in the ECI, which would imply a greater sophistication of exported products and, therefore, a greater perceived economic reward for those who export.

Bioenterprises are more complex than other areas of entrepreneurship due to the technical validation of biological resources, the use of specialized equipment and the need for initial investment. In Latin America, the development of bioenterprises is hampered by lack of access to specialized infrastructure and high capital requirements. Therefore, VC appears to be an opportunity for their development, but it requires certain conditions related to the stability or internationalization of the business, as well as elements of institutional security that reduce investment risks.

Although each Latin American country has relevant strengths in terms of training, innovation, and the development of the bioeconomy, the lack of regional legal frameworks, as well as the scarcity of institutions in this field, make it difficult to attract the capital necessary for the growth of bioenterprises.

Regional bioeconomic integration can be an opportunity to attract risk capital to Latin American bioenterprises, as it facilitates the exchange of knowledge, protocols for exporting their products and coordination according to the production chains of each country.

Indeed, for such integration to be effective, it requires both public and private intervention. Public intervention will be central to the extent that it provides institutionality, and private intervention will be responsible for facilitating capital investment. The former will create the enabling spaces to attract investment and facilitate innovation processes, while the latter will support the strengthening of bioenterprises, which are increasingly in demand, reaching values of $1.43 billion, with bioenterprises from Brazil, Chile, Colombia, Mexico, and Argentina standing out (Endeavor, 2021), demonstrating a high supply of venture capital for the region.

This reality undoubtedly shows how the intervention of non-traditional actors is becoming essential in the development scene of countries, especially in the field of bio-enterprises. This does not mean that traditional actors such as the state are being displaced, but rather that their role is complementary to that of external actors, to the extent that innovation in bioeconomy is largely driven by private capital.

Throughout history, regional integration has been addressed through various initiatives that, despite having faced numerous challenges, should not necessarily be regarded as an unfruitful path for regional growth. The added value of this proposal lies in its approach, which does not focus on creating new mechanisms, but rather invites reflection on the possibility of revitalizing existing spaces, adapting them to the needs of regional bioentrepreneurship to attract venture capital.

While the new regionalism presents certain challenges related to sustainability and social cohesion, a bioeconomic approach could mitigate these difficulties by integrating environmental and social considerations into the processes of innovation and business development. In this way, it is possible not only to achieve greater competitiveness but also to establish a more inclusive and sustainable growth model, aligned with sustainable development goals.

Despite the long history of integration frameworks in Latin America, efforts in regions such as the Andean Community and MERCOSUR have primarily been conceived as general cooperation structures. However, it is worth noting that these spaces have increasingly incorporated the development of bioeconomy technologies, a sector that is particularly attractive to venture capital (VC).

Nonetheless, this proposal carries the risk of continuing to support exclusively emerging bioeconomy technologies, which could result in an uneven distribution of innovation and exacerbate some of the tensions raised by the new regionalism. However, it is also possible that, depending on the governance adopted, and drawing on successful experiences from other regions, as indicated by Liu, Cui, Chen, and Xiu (2023), greater homogenization in access to innovation could be achieved, which may foster a more inclusive and dynamic business environment. If implemented effectively, this approach could represent a significant advancement in regional integration, balancing existing disparities and promoting a more equitable development of resources.

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Annexes section

Table 1.

Country abbreviation

1AE United Arab Emirates	FI Finland	NG Nigeria
AR Argentina	FR France	NI Nicaragua
AU Australia	GH Ghana	NL Netherlands
BE Belgium	GT Guatemala	NO Norway
BO Bolivia	HK Hong Kong	NZ New Zealand
BR Brazil	HN Honduras	PA Panama
BT Bahamas	ID Indonesia	PE Peru
BZ Belize	IL Israel	PY Paraguay
CA Canada	IN India	RU Russia
CH Switzerland	IT Italy	SA Saudi Arabia
CL Chile	JM Jamaica	SE Sweden
CN China	JP Japan	SG Singapore
CO Colombia	KE Kenya	SN Senegal
CR Costa Rica	KR South Korea	SV El Salvador
DE Germany	MA Morocco	TH Thailand
DK Denmark	MG Madagascar	TR Türkiye
DO Dominican Republic	MX Mexico	TW Taiwan
EC Ecuador	MY Malaysia	TZ Tanzania
EG Egypt	MZ Mozambique	UG Uganda
Is Spain	NA Namibia	UK United Kingdom