Regional Innovation Policy in Latin America: Exploratory Analysis

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Abstract: Despite past failures related to industrial policy, most Latin American countries see the regional perspective as a viable alternative for innovation policy. This paper explores how regional innovation policy is implemented in some regions of Lain America. The case study considers 14 regions located in 4 countries: Argentina, Colombia, Chile and Peru. The study analyzes the perceptions of experts about the policy instruments implemented in each region and the regional capacity to implement their own initiatives. The results show that different types of instruments are implemented; however, the capacity to implement regional policies differs among them, and the policy at national level could affect it. It is concluded that the regional innovation policy needs the political empowerment of local territories and the management of geographical and non-geographical aspects. Likewise, the technological aspect could be key when local territories have low political empowerment.

Keywords: Regional innovation policy, Innovation systems, territory, Latin America

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1. Introduction

Innovation is a critical concept related to the economic development and competitiveness of firms, regions, and nations. This is the heart of evolutionary economics. It abandons the concepts of equilibrium and optimization. Instead, it focuses on learning, novelty creation, sophistication and diffusion of knowledge (Marshall, 1920) (Metcalf, 1995) (Nelson, 2005) (McKelvey, 2005). It has provided fundamental foundations for developing science, technology and innovation (STI) and industrial policies in recent decades (UNIDO, 2005) (Malerba, 2002).

One of the fundamental approaches has focused on promoting innovation systems (IS) as sources of the emergence of technologies and significant network externalities (Nelson, 1993) (Edquist, 2005) (Carlsson, 2006) (Malerba, 2004). In this sense, policies focus on the promotion of interaction and networks (Klein et al., 2005) and the reinforcement of physical (e.g. harbours) and knowledge infrastructures (e.g. research laboratories) (Smith, 2005).

In the case of developing nations, the emergence of solid and well-established innovation systems (IS) would appear a complicated occurrence. In these countries, markets are not well developed, and there is a poor business climate (Navarro et al.,2016). Individual firms often lack the incentive, expertise, and resources to undertake innovation-based strategies (Chandra, 2006) and, in general, there would be a severe lack of resources (UNIDO, 2005), poor institution development (Sagasti, 2011) and a weak innovation policy (UNCTAD, 2011).

Despite this, political intervention has played an essential role in the industrial transformation processes of catching up with countries (Jacobsson and Bergek, 2006) (Chandra, 2006). Different Latin American governments have promoted STI through institutional arrangements to support several initiatives, such as laws, national plans, and other policy instruments. (Padilla-Pérez and Yannick Gaudin, 2013). Although these initiatives have mostly had a national approach (Navarro et al., 2016) (Rodrik, 2005, p.21) (Crespi et al., 2014), recent international contributions have highlighted the importance of the territorial and regional approaches (Mowery and Nelsson, 1999) (Hauser et al., 2007) (Eklindeer-Frick & Åge, 2017) (McCann and Ortega-Argiles, 2014) (Foray et al., 2009). This suggests exploring how these initiatives are being developed from a regional and territorial approach in Latin American countries.

This paper explores how regional innovation policy is implemented in some Latin American regions. The case study considers 14 regions located in 4 countries: Argentina, Colombia, Chile and Peru. It uses empirical evidence from questionnaire-based interviews conducted with high-level government officials in each region. The study assesses the experts' perceptions about (1) The policy instruments implemented in each region; (2) The capacity of the regions to implement innovation policies; and (3) The level of formalization of regional innovation policy mechanisms. The information obtained was analyzed considering territorial elements such as the geographical/territorial level and the political empowerment of the territorial spaces; likewise, non-territorial aspects such as political, sectoral and technological were considered.

The empirical evidence was obtained from a questionnaire designed by the authors to be answered by high-level representatives whose main professional activities are highly related to the development and implementation of the regional innovation policy in each region evaluated. The questionnaires were conducted from 2019-to 2020. The document is divided into six sections. The first section is an introduction. The second section deals with the literature on the fundamentals of innovation policy mainly at the regional level, primarily addressing the European experience in contrast to the Latin American experience. The third and fourth section shows the methodology used and the results obtained. The fifth section analyzes the empirical evidence collected, discussing some implications for the development of RIP implementation that could be taken as a reference or lessons learned for other regions. The sixth section presents the conclusions.

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2. Literature Review

2.1 Promotion of innovation

The promotion of innovation has had some conceptual changes over time. In a first approach, named the "linear model", firms and other actors were assumed to be perfectly informed about all relevant factors, and markets were considered equilibrium. The policy focused on correcting market failures to increase market efficiency (Jacobsson et al., 2017) and providing R&D infrastructure, financing of innovation and technology transfer (Tödtling & Trippl, 2005). However, this model could have ignored the dynamics of technological change and industrial development (Jacobsson et al., 2017) and would not have been able to consider the absorptive capacity of firms and the specific demand for innovation support in less-favoured regions or catching-up countries (UNIDO, 2005).

The concept of innovation systems (IS) has emerged, offering a more flexible approach for a rigorous assessment of industrial evolution and technological change (Edquist, 2005) (Carlsson, 2006) (Malerba, 2004). Different methods can be identified in the literature: National Innovation Systems (NIS), Regional Innovation Systems (RIS), Sectoral Innovation Systems (SIS), and Technological Innovation Systems (TIS). Although they answer specific questions, they all aim to describe innovation and technological change processes by evaluating the agents involved and their interactions concerning the particular context (Mowery and Nelson, 1999).

National Innovation Systems focus on national capabilities, usually regardless of technology or sectors (Nelson, 1993). Sectoral Innovation Systems focus on industrial sectors, that is, on a set of established or new products for specific uses (Malerba, 2002). There are not geographically restricted and are often international in scope. Nor are they limited to a particular technology. This allows, in particular, to capture technological substitutions and the co-evolution of different technologies within specific industries (Mowery and Nelsson, 1999). Technical innovation systems (TIS) focus on the generation, diffusion and utilization of particular technologies (Carlsson and Stankiewitz, 1991). They can be defined as a network of agents interacting in a specific technological area under a particular institutional infrastructure to generate, diffuse, and use a particular technology (Carlsson & Jacobsson, 2005, p.268). The assessment may cover several industry sectors, for example, factory automation (Carlsson, 1995) or bio-industry (Carlsson, 2002).

2.2 Economic geography and RIS

Economic geography is characterized by knowledge as a source of competitiveness and the region as a platform for aggregation. (Hauser et al., 2007) Then, innovation is achieved through constructing a regional innovation system (Eklindeer-Frick & Åge, 2017).

This implies the need to analyze a "concentration factor" or "critical mass". A century earlier, Marshall (1920) proposed the "industrial districts" approach, and later Porter (1998), that of Industrial Clusters; however, even though a RIS overlaps with a cluster, there could be several clusters and many industries in a RIS (Eklindeer-Frick & Åge, 2017).

The UE has adopted a regional approach to promoting innovation. The concept, known as smart specialization, adopts reasoning that supports that innovation policies should focus on sectors with a real opportunity to stand out in the global market while recognizing that not all areas have the same growth potential (European Commission, 2012); therefore it would be more effective to "concentrate" resources for R+D+I in certain areas of specialization (McCann and Ortega-Argiles, 2014) (Foray et al., 2009) (Sandu, 2012), which can lead to a technical transformation and the emergence of new technologically advanced industries (Gulc, 2015).

How a region identifies those areas of interest has different methodological foundations. Among them of particular interest is that process called entrepreneurial discovery. (Hausmann & Rodrik, 2003) (Foray, 2014) (Gheorghiu et al., 2016).

2.3 Regional innovation policies (RIP)

According to the European Commission (2012), there are many public policy alternatives that regions can implement to strengthen regional innovation systems. Various innovation policy instruments have been proposed over decades. Each instrument responds to particular objectives under a specific rationale (Edler et al., 2016). For example, OECD (2013) suggests three types of instruments: traditional, emerging or experimental. Each would be oriented to fulfil specific objectives such as generating, spreading or exploiting knowledge.

Navarro et al. (2016) propose two public innovation policy dimensions. The first, named public good, would increase the levels of innovation activity (e.g. education, training, technology transfer, etc.). The second, called market intervention, would provide funds for firms and economic actors (e.g. R&D subsidies, R&D tax credits, etc.). At the same time, these interventions could be applied horizontally (if they are used transversally across all economic activity) or vertically (if they are involved in specific sectors, value chains or clusters) (e.g. industry-specific training programs, strategic sectors or clusters, etc.).

The vertical dimension of innovation policies is of particular importance for this work. Foray (2014) shows that a non-neutral policy is a key to the so-called new industrial policy plan, based on economic geography and smart specialization. At the same time, active approaches to support specific sectors at different stages of development have been vital to emerging countries, for example, the success of advanced chemicals in Korea (Crespi et al., 2014).

There is no " ideal model " for the formulation of a set of regional innovation policies; there is no "ideal model" (Tödtling and Trippl, 2005). Then it must be aligned with an evaluation of the region's economic, social, technological context (OECD, 2013). For example, the World Bank (2010) suggests the selection of three types of policy instruments based on the level of innovation and human capabilities: (1) technology creation, (2) technology adaptation, and (3) technology adoption.

Accordingly, different taxonomic forms have been proposed to group regions of similar typology in which similar instruments could be

implemented. Tödtling and Trippl (2005) mention the differences regarding preconditions for innovation, innovation activities and processes between central, peripheral and old industrial regions. Foray (2014) takes the EC (European Commission) classification of regions into three main categories: less developed regions, transition regions, more developed regions, arguing that the intelligent specialization policy framework provides strategies and roles for any region. OECD (2013) describes four types of regions and proposes according to STI strategies (See Table 1).

Table 1: Types of regions and STI Strategies compiled by OECD

Type of Region	Strategy
Knowledge and technology hubs (Leading science and technology regions)	Reinforcing excellence in knowledge creation and developing new high-tech industries
Medium-tech manufacturing and service providers (Industrial production regions with relatively high knowledge absorptive capacities)	Modernizing productive activities towards value-added niches: "innovation ecosystem strategy."
Structural inertia or de-industrializing regions (Non-S&T-driven regions with persistent development traps)	Stimulating knowledge absorption and entrepreneurial dynamism
Primary-sector-intensive regions (Generally rural areas in lesser developed OECD countries, specialized in primary sector activities)	Upgrading and retaining human capital, creating critical mass and increasing the quality of connectivity

Source: OECD (2013)

This classification has been taken as the primary reference for the methodology of the present work.

2.4 Innovation policies in Latin America

Latin American countries invested an average of 0.7% of GDP, which shows a much lower R&D orientation than OECD countries, which supported 2.4% (Crespi et al., 2014). They face obstacles to innovation such as weak linkages between actors; low absorptive capacity (Maloney & Perry, 2005); markets and firms tend to be smaller than they should optimally be; scarcity of complementary products; scarcity of specialized managers, knowledge brokers, technicians, and engineers; good management practices have often not spread; weak market incentives constrain the emergence of new innovative firms (Navarro et al., 2016).

Despite this, Latin American countries have implemented different innovation policy instruments such as STI planning, intellectual property rights, public education system, standardization, metrology and quality policies, public procurement policies, financing of fiscal incentives, direct subsidies for R&D activities, public-private binding organizations, business incubators, etc. (Padilla-Perez & Gaudín, 2013) (Maloney & Perry, 2005). The instrument of choice throughout the region tends to be innovation funds that allocate resources to private companies for innovation projects on a competitive basis (Navarro et al., 2016).

Traditionally, STI instruments have been a demand-led approach, focusing on tackling market failures (Padilla-Pérez & Yannick Gaudin, 2013). There has been a historical aversion to implementing industrial policies of a sectoral nature (Crespi et al., 2014). Past failures could explain this. Specifically, during the 1980s, some Latin American countries implemented an industrialization process through import substitution; however, the absence of punishment brought inefficient sectors that could not face the international competition of the market globalization measures adopted in the 90s. This resulted in eliminating many industries and companies, leaving a few survivors (Rodrik, 2005, p.21).

However, governments have chosen to provide strategic direction to support initiatives in particular industries or technology areas, deploying sector-specific innovation funds in the last decade (Navarro et al., 2016). More recently, the European approach of Smart Specialization has been considered by several LA countries and regions (Haarich, 2018); however, the state of implementation may be in a very initial phase (Barroeta et al., 2017), and there would be some factors considered as shortcomings for its application, such as poor regional political autonomy or centralization (Innopro & Alias 2015) (Padilla-Pérez & Yannick Gaudin, 2013) (Barroeta et al., 2017), the absence or lack of clear identification of regional innovation strategies (Innopro & Alias 2015), limited financial resources and limited evaluation systems and indicators applied at the regional level (Barroeta et al., 2017).

3. Methodology

To study how regional innovation policy is implemented in some Latin American regions, we conduct a case study to analyze, in an exploratory way, experts' perceptions of: (1) the policy instruments implemented in each region; and (2) the capacity of the regions to implement their innovation policies.

It uses empirical evidence from questionnaire-based interviews conducted with a high-level government official in each region.

Experts belong to the following regions: San Juan, Santa Fe and Formosa (Argentina); O´Higgins, Coquimbo, Aysen and Bio Bio (Chile); Antioquia, Cundinamarca, Arauca (Colombia); Arequipa, Ayacucho, Cajamarca and Huancavelica (Peru).

We opted to study the regions of Argentina, Colombia and Chile, as they are more developed countries in terms of promoting innovation, for example, in the case of investment in R&D (Pasciaroni, 2016).

As for the analysis for the focus on innovation policy, we considered different innovation policy instruments and initiatives considered in recent literature, grouped considering four different types of approaches for strategy adopted by OECD (2013) (See Table 1).

Table 2: Innovation policy instruments consulted with experts

OBJECTIVE	INNOVATION POLICY INSTRUMENT	CODE	SOURCE
EMPOWERING AND MAINTAINING HUMAN CAPITAL, CREATING CRITICAL MASS AND INCREASING CONNECTIVITY BETWEEN ACTORS	Regional Business Development / Export Promotion Agencies	A1	OECD (2013)
	Promotion of permanent training courses aimed at entrepreneurs and companies	A2	Padilla y Gaudin (2013), OECD (2013)
	Promotion of exchange programs (scientists - professionals) and/or talent attraction schemes	A3	Padilla y Gaudin (2013), OECD (2013)
	Regional incentives for business skills upgrading programs	A4	OECD (2013)
	Incentives for hiring qualified personnel in companies	A5	OECD (2013)
	Creation of knowledge/research centres in traditional areas of national research	A6	OECD (2013) Crespi, Fernández-Arias, and Stein (2014)
	Promotion of the participation of regional actors in national/international business networks	A7	Crespi, Fernández-Arias, and Stein (2014)
	Financing of experimental, innovative regional projects	A8	Padilla y Gaudin (2013), OECD (2013)
	The attraction of national investment in tertiary/specialized education	A9	OECD (2013)
	Investment/programs in mechanisms to generate business-university-state connectivity	A10	OECD (2013)
STIMULATING KNOWLEDGE, ABSORPTION CAPACITY AND ENTREPRENEURIAL DYNAMICS	Web-based technical question-answer service for innovation development	B1	Deng, Lui and Qi (2011), Smits and Kuhlmann (2004)
	Business innovation brokerage service	B2	OECD (2013)
	Prospective regional studies and search for niche markets with added value	B3	Padilla y Gaudin (2013), OECD (2013)
	Knowledge dissemination centers	B4	Avnimelech and Teubal (2007).
	Innovative business incubator service	B5	OECD (2013); Crespi, Fernández-Arias, and Stein (2014)
	Knowledge/research centers in regional priority research lines	B6	Avnimelech and Teubal (2007)
	Promotion of training of actors/venture capital companies	B7	OECD (2013); Avnimelech and Teubal (2007); Crespi, Fernández-Arias, and Stein (2014)
	Support for business clusters with potential for innovation	B8	Avnimelech and Teubal (2007); OECD (2013)
	Promotion of culture for innovation and entrepreneurship	B9	Padilla y Gaudin (2013), OECD (2013)
	Regional public purchases to promote innovation in companies	B10	Padilla y Gaudin (2013), OECD (2013)
	Finance or co-finance technology transfer centers	B11	Padilla y Gaudin (2013)
	Industry-science connection support programs (industrial PhD, technology consulting, etc.)	B12	Padilla y Gaudin (2013)
	Promotion of technological startups (angel business, mentoring, venture capital)	B13	Crespi, Fernández-Arias, and Stein (2014)
MODERNIZING PRODUCTIVE ACTIVITIES TOWARD VALUE-ADDED NICHES: DEVELOPING AN INNOVATIVE ECOSYSTEM	Promotion of credit for companies for the acquisition of technological services from knowledge centers	C1	OECD (2013)
	Support for connecting regional clusters to global networks	C2	Padilla y Gaudin (2013), Avnimelech and Teubal (2007)
	Financing (by competition) for research / cooperative research (university / company) / venture capital	C3	Padilla y Gaudin (2013), Crespi, Fernández-Arias, and Stein (2014); Avnimelech and Teubal (2007)
STRENGTHENING EXCELLENCE IN KNOWLEDGE CREATION AND DEVELOPMENT OF HIGH TECHNOLOGY INDUSTRIES	Promotion of national/international excellence research programs	D1	OECD (2013) Avnimelech and Teubal (2007)
	Promotion of the participation of regional public / private actors in international technology networks	D2	OECD (2013); Crespi, Fernández-Arias, and Stein (2014)
	Support for technology clusters, science parks, technology parks	D3	OECD (2013)

Source: the authors.

To analyze the capacity of regional innovation policy, we used four indicators, as they are shown in Table 3.

These indicators try to show the degree of empowerment of regional governments concerning the generation and implementation of regional innovation policies. In this sense, it was sought to analyze the degree of decentralization in decision-making about the CTI policy, the degree of maturity of the activities related to the CTI policy, the organisms in charge of generating and implementing it, and finally, the available resources. For example, a region that has a plan to implement initiatives to promote STI but does not have an assigned budget could be interpreted as a process of maturity that is still under development.

Table 3: Evaluation criteria and scale for RIP capacity

Evaluation criteria (EC)	Evaluation scale			
	High	**Medium**	**Low**	**Non-existent**
EC1: Degree of decentralization of decision making and resources regarding STI policy	Significant control of decision making in STI and/or resources in the regions	Some level of decentralization of decision making in STI and/or resources in the regions	No decentralized decision making of STI in the regions (they only implement regional strategies)	No decentralized decision making of STI in the regions (they only implement innovation projects)
EC2: Degree of formalization/maturity of the regional policy	There is a regional policy and a regional strategic plan in STI, which are mature, and are being implemented	Regional policy and strategic plan prepared with a low level of implementation	There is a theoretical policy that does not have operational instruments	There is no policy or functional instruments
EC3: Development of the executing body of innovation policies	There is an office/body with exclusive responsibility for promoting innovation. This body has maturity and experience.	There is an office with exclusive innovation functions. This has been recently created.	There is an office/body that includes the promotion of innovation, but that carries out other types of activities in parallel.	There is no office/body to promote innovation.
EC4: Resources deployed for the regional promotion of innovation	Relevant fixed resources that allow financing policies, strategies, projects	Non-relevant fixed resources. They will enable the implementation of minor actions to promote innovation	Non-fixed eventual resources deployed to encourage innovation	There are no resources to promote innovation

Source: the authors.

Experts were also consulted about the level of formalization of the national innovation policy:

EC5: Formalization of national innovation policy	There is a national policy and a national strategic plan for STI, which are mature, and are being implemented	National policy and strategic plan prepared with a low level of implementation	There is a theoretical policy that does not have operational instruments	There is no policy or functional instruments

Source: the authors.

For each of these indicators, a Likert scale was developed so that the respondent could choose an alternative according to their perception. The answers obtained were interpreted considering a numerical scale. For example, a "high" evaluation on the scale corresponds to a level 3, and a "non-existing" evaluation corresponds to a value of 0. The different responses could be processed with the numerical values, for example, to obtain average values.

4. Results

4.1 Regional innovation policy (RIP) implemented by region

The following results show different policy instruments implemented by the regions. The codification is according to Table 2. We only considered instruments that are being implemented with permanent resources.

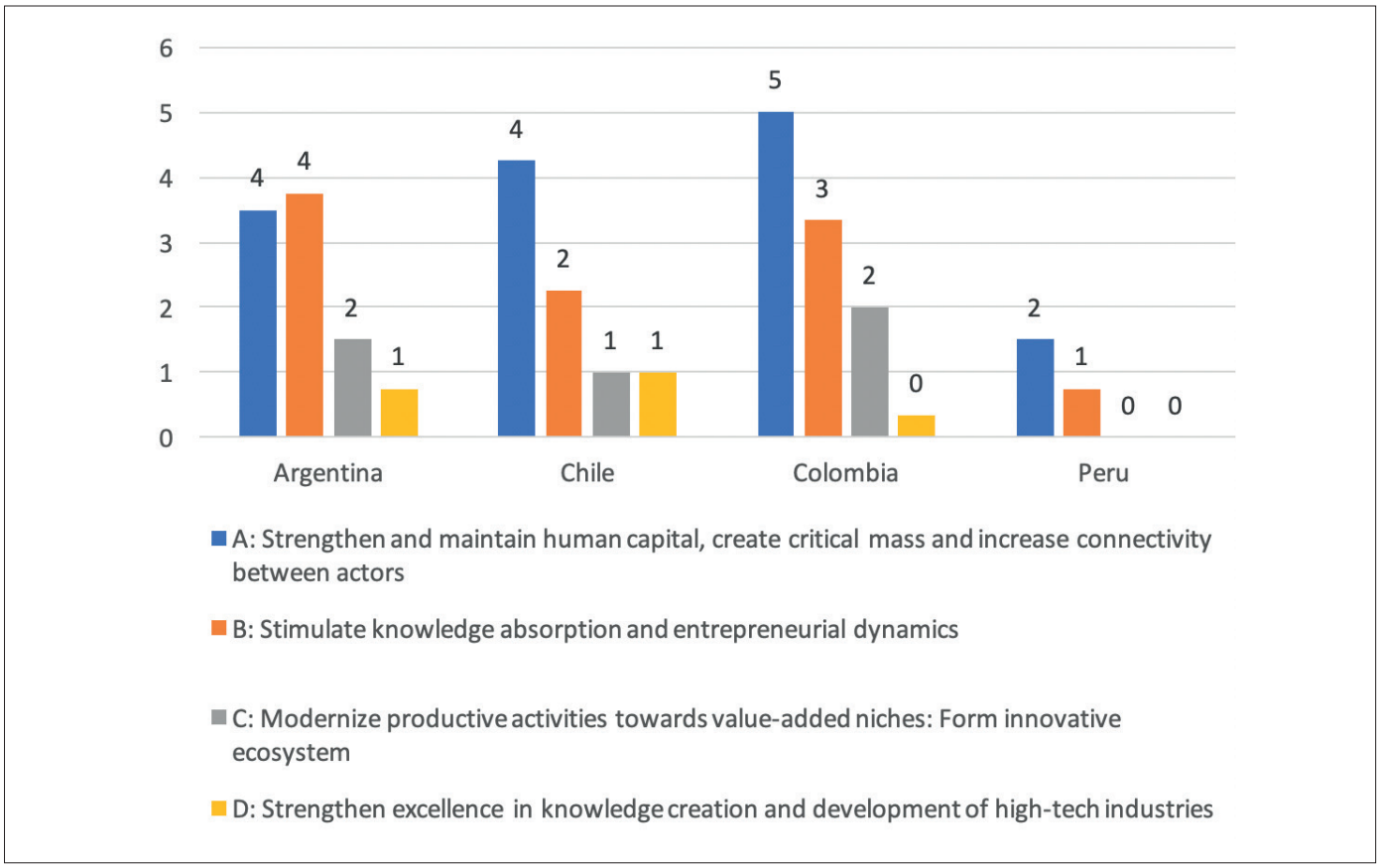
Table 4: Policy instruments by type and region

Instrument	San Juan	Santa Fe	Formosa	O´Higgins	Coquimbo	Aysén	BIO BIO	Antioquia	Cundinamarca	Arauca	Arequipa	Ayacucho	Cajamarca	Huancavelica	Total instruments
A1		X		X	X			X		X	X				6
A2		X	X	X	X			X		X	X				7
A3		X		X	X										3
A4		X		X	X			X		X			X		6
A5				X	X										2
A6	X	X	X	X	X			X	X		X				8
A7			X	X						X					3
A8		X	X	X	X			X	X	X			X		8
A9			X						X						2
A10		X	X	X	X			X	X				X		7
B1		X						X		X					3
B2		X		X						X					3
B3		X			X					X	X		X		5
B4	X		X												2
B5				X											1
B6			X	X	X	X		X							5
B7	X	X		X											3
B8		X	X					X		X					4
B9	X	X	X	X	X			X		X			X		8
B10		X	X							X					3
B11			X					X	X						3
B12		X	X	X											3
B13		X		X	X										3
C1										X					1
C2								X							1
C3	X	X		X				X	X						5
D1	X	X		X	X										4
D2				X	X										2
D3		X						X							2
A	1	7	6	9	8	0	0	6	4	5	3	0	3	0	52
B	3	9	7	7	4	1	0	5	1	6	1	0	2	0	46
C	1	1	0	1	0	0	0	2	1	1	0	0	0	0	7
D	1	2	0	2	2	0	0	1	0	0	0	0	0	0	8
TOTAL	**6**	**19**	**13**	**19**	**14**	**1**	**0**	**14**	**6**	**12**	**4**	**0**	**5**	**0**	**113**

Source: the authors.

As Table 4 shows, the most active regions are Santa Fe (Argentina), O´Higgins (Chile), Coquimbo (Chile), Antioquia (Colombia), Formosa (Argentina) y Arauca (Colombia). At the same time, the most used instruments are A6 (Creation of knowledge/research centers in traditional areas of national research), A8 (Financing of experimental, innovative regional projects), B9 (Promotion of culture for innovation and entrepreneurship), A2 (Promotion of permanent training courses aimed at entrepreneurs and companies), A10 (Investment/ programs in mechanisms to generate business-university-state connectivity), A1 (Regional Business Development / Export Promotion Agencies) and A4 (Regional incentives for business skills upgrading programs).

Figure 1: RIP implemented grouped by country



Source: the authors.

Regarding the number of RIPs implemented for each region grouped by country, Figure 1**.** shows the policy instruments implemented by the regions, framed in the four strategic areas suggested by OECD (2013) (Table 2). The results show that the regions of Argentina, Chile and Colombia, implemented, on average ten regional policies, while in the case of the regions of Peru, only 3. Most of the implemented instruments are focused on upgrading or retaining human capital, creating critical mass, increasing the quality of connectivity (A), and Stimulating knowledge absorption and entrepreneurial dynamism (B).

4.2 Capacity for implementing own regional innovation policy (RIP)

Table 5 shows the evaluation results carried out by the experts in each region. It can be noted that, in the case of some regions, the four evaluation criteria (Table 3) receive a similar valuation. In the case of other regions, the criteria receive a variable rating.

Table 5: Development of RIP by region

Country	Region	Evaluation Criteria	Level of Development			
			Non-existent	Low	Medium	High
Argentina	San Juan	EC 1			X	
		EC 2			X	
		EC 3			X	
		EC 4			X	
	Santa Fe	EC 1				X
		EC 2				X
		EC 3				X
		EC 4			X	
	Formosa	EC 1			X	
		EC 2			X	
		EC 3			X	
		EC 4		X		
Chile	O'Higgins	EC 1				X
		EC 2				X
		EC 3				X
		EC 4				X
	Coquimbo	EC 1			X	
		EC 2			X	
		EC 3		X		
		EC 4				X
	Aysén	EC 1			X	
		EC 2			X	
		EC 3		X		
		EC 4				X
	BIO BIO	EC 1			X	
		EC 2			X	
		EC 3		X		
		EC 4		X		

Country	Region	Evaluation Criteria	Level of Development			
			Non-existent	Low	Medium	High
Colombia	Antioquia	EC 1			X	
		EC 2				X
		EC 3				X
		EC 4		X		
	Cundinamarca	EC 1				X
		EC 2			X	
		EC 3				X
		EC 4				X
	Arauca	EC 1		X		
		EC 2			X	
		EC 3		X		
		EC 4			X	
Perú	Arequipa	EC 1		X		
		EC 2		X		
		EC 3		X		
		EC 4		X		
	Ayacucho	EC 1		X		
		EC 2		X		
		EC 3	X			
		EC 4	X			
	Cajamarca	EC 1		X		
		EC 2			X	
		EC 3		X		
		EC 4		X		
	Huancavelica	EC 1	X			
		EC 2			X	
		EC 3		X		
		EC 4	X			

EC 1: Degree of Decentralization of Competencies and Resources in Science and Technology Policy

EC 2: Level of Formalization / Maturity of Regional Policy

EC 3: Level of Formalization of The Executing Body of Innovation Policies

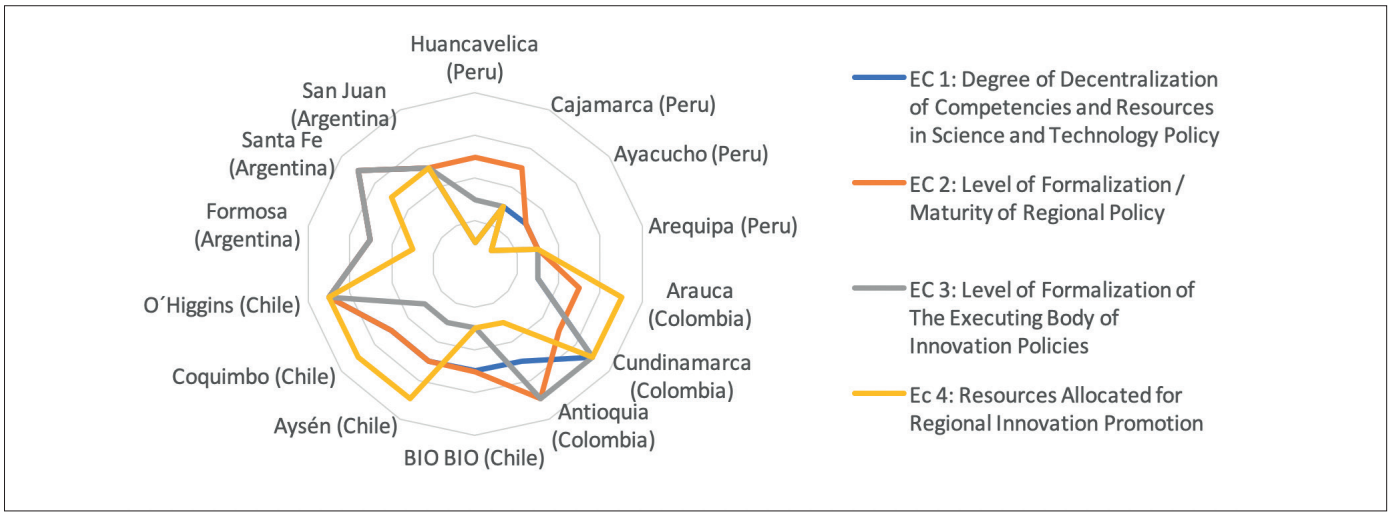
EC 4: Resources Allocated for Regional Innovation Promotion

Source: the authors.

Although the main objective of the analysis is not the absolute comparison between countries, with the available data, a grouping of the answers "by country" was carried out to explore if there are some factors at the national level that could affect the capacity of the regions for RIP implementation.

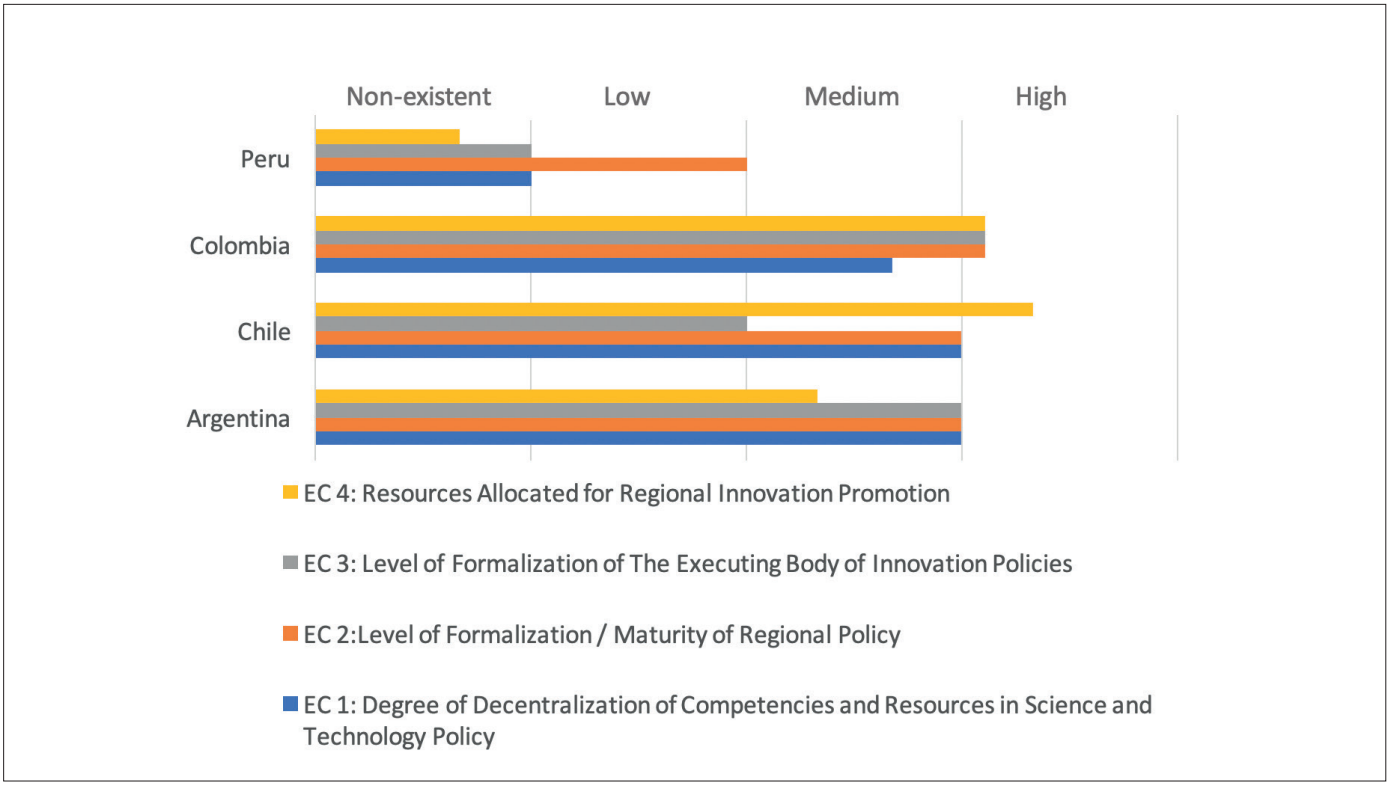
According to Figure 2 and Figure 3, the experts' perception of the ability to implement regional innovation policies shows differences in each of the four criteria evaluated. Initially, it can be noted that the capacity in the Peruvian regions is low and comparatively less than the regions belonging to the other countries. It can be pointed out that a medium level of formalization of the regional innovation policy is recognized but that there are few resources deployed. On the other hand, the least developed criterion was the level of decentralization and resources in science and technology policy. In the case of Colombia, Chile and Argentina, they show a medium capacity, with specific differences between the criteria evaluated.

Figure 2: Capacity for RIP implementation by region



Source: the authors.

Figure 3: Capacity for RIP implementation grouped by country

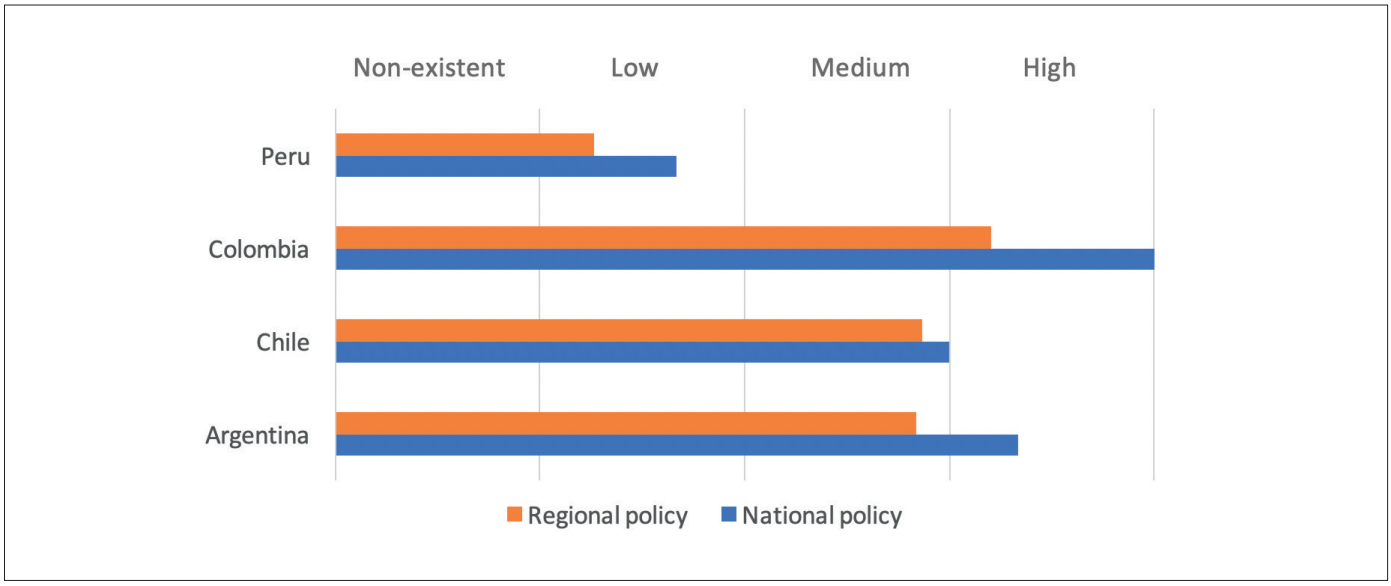


Source: the authors.

4.3 Capacity for RIP implementation and national innovation policy (NIP)

Experts were also consulted about the level of formalization of the national innovation policy to analyze if there is any relation between national policy formalization and regional policy implementation capacity. (See EC 5, Formalization of national innovation policy, Table 3)

Figure 4: Degree of Development of RIP vs Formalization of National Innovation Policy (NIP)



Source: the authors.

Figure 4 shows an analysis of the average capacity for the development of RIP of the regions grouped by country, taking into account, at the same time, the level of formalization of the national innovation policy. This analysis showed particular relation that would imply a positive connection between these variables.

5. Discussions

The previous results allow us to highlight two inferences: First, the regions present different levels of development of regional innovation policy, from those that, according to experts, seem to have a high capacity to support innovation to others that seem to have a low or non-existent ability. At the same time, regions have implemented a different kinds of instruments, most linked with supporting human capital, connectivity, knowledge and entrepreneurship. This would imply that leadership and own initiatives are essential inputs for regional policy development; however, as the results averaged by the country show, there could be influencing factors associated with the national context that could promote or hinder the development of regional innovation policies.

Secondly, the more remarkable development of RIP occurs in contexts where a greater degree of formalization reached by national policies is shown. This would indicate that regional policy is more developed in an environment where the national government understands the need to empower the regions.

This brings up three themes for discussion, considering the implications of regional innovation policies in the context of Latin American regions: (1) The importance of territorial level, (2) The political empowerment of territorial spaces, (3) The role of non-geographic aspects.

5.1 The importance of territorial level

When the regional or local government has available instruments and a certain degree of empowerment, it can implement a set of different policy instruments that could align with its reality despite the instruments implemented in other regions. Therefore, the territorial aspect and regional innovation systems (RIS) approach become relevant. Here concepts such as: "geography matters" (Morgan, 2004, p. 4) and "Territorial innovation" (Moulaert & Sekia, 2003) become essential; even for "catching up" countries, where the increased local appropriation of innovation leads to better economic performance and growth trajectory (Kim & Lee, 2022).

According to many scholars, the geographical aspect is critical for several reasons: Knowledge and Tacit knowledge sharing is facilitated by geographical proximity (Morgan, 2004) (Tödtling & Trippl, 2005) (Ferreira et al., 2015); information and communications are influenced by spatial aspects (Cooke, 2003) (Morgan, 2004); Governance of innovation is partly linked to subnational territories (Cooke et al., 1996) (Tödtling & Trippl, 2005).

Additionally, Autio (1998) argues that regional innovation systems (RIS) are distinctly different from national innovation systems, and other approaches are needed for their evaluation. Thus, it would be possible to argue that the inclusion of a regional innovation policy (under an economic geography approach) will be more effective when fostering innovation compared to a single national-territorial approach. As stated Ferreira et al. (2015), innovation could be managed effectively at the regional level due to the localized nature of knowledge spillovers, absorptive capacity, technological transference, manufacturing set-up, and new business formation. In our view, a national level is more aligned to a linear model of innovation policy based on the supply of support instruments and innovation inputs such

as R&D infrastructure, financial innovation support for companies, and technology transfer. (Tödtling & Trippl, 2005) In the same way, a national scope would appear more aligned to be horizontal and technologically neutral, as shown in the case of several Latin American countries (Padilla-Pérez & Yannick Gaudin, 2013).

Finally, it is assumed that a regional territorial level would not be the ultimate level of innovation governance. For example, Mayer et al. (2016) argued that capital cities play their role as capitals. These capitals develop a unique regional innovation system through locational policies formulated in local governments.

5.1 The political empowerment of territorial spaces

According to the previous statements, a new element for discussion may arise: If a smaller scope of government, that is, not only regional level but local (micro-level), would improve the effectiveness of specific policy instruments.

To discuss this, it would be necessary to consider the hierarchical level of innovation policy in the country, or in other words, the level of political empowerment of territorial spaces: regions or localities. Some regions in Latin America seem to be more empowered in designing and implementing their policies than others. As shown previously, the analyzed regions of Argentina, Colombia, and Chile showed greater maturity in the Development of Regional Innovation Policy (RIP) than Peru's regions. In the case of Peru, it could be said that the poor empowerment shown by the analyzed Peruvian regions is a result of the centralized condition of the innovation policy in the country.

On the other hand, the territorial context of each region will be related to specific socio-technological conditions (Tödtling and Trippl, 2005), like particular types of clusters, foreign companies, or populations. For example, some regions in Perú are composed of different territories with different socio-technical conditions. The capital province could have a medium level of technological development in the industrial sector. But, this capital, at the same time, could be surrounded by rural provinces with no industrial development at all. Terje (2019) states that some more peripheral regions of a region may have an unskilled labor market, an SME sector with low absorptive capacity, or low social capital and trust. These conditions create difficulties in finding a development path or building a regional innovation system. In this context, implementing a regional policy (only from a territorial perspective) designed to fit the needs of all the local territories would be a challenging task.

Accordingly, specific policy instruments implemented at the regional level might not be the most appropriate to match the needs of different actors, networks, and institutions in smaller localities distributed in that region. In this case, the political initiative will lose specificity or, in other words, accuracy. Therefore, innovation policy at the local or micro level would be more appropriate in some cases. This will conclude that the political context, such as centralization and the empowerment of lower levels, has an important impact on the territorial/spatial level in which innovation policies are developed.

5.2 Role of non-geographical aspects

Even when a more local or micro approach could be better adjusted to the needs and expectations of local actors, networks and institutions, one last element of discussion arises: would only the geographical aspect, such as the definition of a smaller territorial scope, be a sufficient criterion to implement an innovation policy instrument?

Bergek et al. (2015) show four types of context structures for analyzing technological innovation systems (TIS): technological, sectoral, geographical and political. Even when the approach considered TIS, these criteria are valuable to this discussion.

For example, the country's political context may have some implications for the regional capacity for stimulating innovation. This may explain the situation of certain Latin American regions that are in centralized political contexts. As the results reveal, the degree of centralization of the innovation policy impacts the development of the regional innovation policy. On the other hand, as mentioned above, some Latin American regions may be reluctant to implement sectoral policies for industrial transformation processes due to past failures (Sagasti, 2011). This leads them to face policy dilemmas (Jacobsson and Alam, 1994, p.59) and, therefore, aversion to policy formulation.

Here, it is interesting to note that the National Innovation Policy of Peru, announced in 2016, is based on eight fundamental principles: excellence, transversality, integrity, sustainability, compensation-adaptability, associativity-cooperation, and interculturality; however, none of them is linked to any spatial/territorial or even sectoral criterion that supposes a certain level of technological specialization, on the contrary, the presence of the principle of transversality stands out. On the other hand, according to the results, Peru has the most notable centrality of innovation policies. Despite this, it is paradoxical to see that some regions, such as Arequipa and Piura, implemented Regional Innovation Agendas, in which strategic sectors and lines of regional specialization were identified (Memoria Agenda de Innovación Arequipa, 2019). Perhaps at the moment, it is premature to comment on the hope of success of these regional initiatives. Still, it can be said that the national political context would not be fully aligned with these initiatives.

The previous discussion leads us to ask if the technological aspect could also help to fit a policy instrument better. Here, the technological innovation systems (TIS) approach can be helpful. This implies that actors are related to particular technology or group of technologies, such as the approach of a sectoral innovation system or the regional strategies of smart specialization. According to Bergek et al. (2015), there is a mutual interaction between TIS and sectors. A sector comprises multiple TIS that provide technologies and products to potential users.

Given that technology is a more concrete or objective criterion than policy or territory, the TIS approach could transcend the "level of political empowerment of territorial spaces". Innovation policies could be implemented from a national, regional or local level focusing on TIS. This implies the need to identify technological or sectorial innovation systems to apply specific policies "more adaptable" to the socio-technological reality. This deserves a deeper analysis.

6. Conclusions

According to the results obtained in this case study, it is possible to conclude, in the first place, that regions present different levels of development of regional innovation policy and have the capacity to implement additional and specific instruments. This would be promoted by leadership and own initiatives, which are essential inputs for developing policies; however, there could be influencing factors associated with the national context that could promote or hinder the development of regional innovation policies.

It is possible to argue that countries with a greater awareness of political empowerment in smaller territorial spaces will be more likely to implement regional innovation policies successfully; this inference can be raised from the evidence found in the cases studied. Therefore, the political empowerment of territorial spaces will be very relevant.

However, according to the results obtained, non-geographical aspects are also crucial for developing successful regional innovation policies. The political element (contextual structure in Bergek et al., 2015) is essential for the Latin American context. This can be explained by the aforementioned historical aversion to the generation of industrial development policies; This situation is evident mainly in countries such as Peru, which shows a more horizontal innovation policy (without considering sectoral aspects) and which, at the same time, presents a high degree of centralization.

Finally, managing sectoral and technological aspects could help transcend the limitations related to low political empowerment of local territories, as in the case of Perú. The TIS approach could be helpful since these initiatives could be developed from a regional or even national level, considering a focus on a specific technology. The last implies the identification and in-depth study of these systems. However, there is still a lack of contributions related to TIS in Latin American countries, which could lead to the assumption that this deserves future attention.

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