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Universities as catalysts of change in locked-in and vulnerable resource-based regions of the Global South

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ABSTRACT

This paper explores the contribution of universities to regional development and innovation in locked-in and vulnerable resource-based regions of the Global South. Building on a regional change agency approach, we identify the combination of key factors and context preconditions for universities to successfully fulfil their local engagement role in a particularly challenging environment. To do so, we use a comparative case study of two mining regions in Peru. Our results reveal that the prevalence of a climate of conflict and the lack of an innovation culture in the regional ecosystem are important challenges, while strategic leadership and institutional capacities are central elements for universities to fulfil their role as transformative agents.

KEYWORDS

Developmental universities; third mission; regional innovation systems; resource-based regions; peripheral regions; change agency; mining; Peru

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1. INTRODUCTION

Over the last decade, economic geography scholars have extensively studied the challenges of economic development in peripheral or left-behind regions (see e.g., MacKinnon et al., 2022), spurred by growing awareness of the 'geography of discontent' (McCann, 2020; Rodríguez-Pose, 2018). While recent research has focused on the spatial disparities affecting Europe and the United States, left-behind regions in the Global South are arguably facing more acute challenges (Tups et al., 2023). These regions have been characterised as 'deep peripheries' (Tups et al., 2023) or 'hyper-peripheral regions' (Barratt & Klarin, 2022), not only because of their limited capacity to integrate in the global economy but also because their most basic human needs and rights are persistently unmet. In this sense, peripheral regions in the Global South risk falling into the 'dark side of regional industrial path dependency', as they are often exposed to 'trajectories of decline' and acute poverty over extended periods of time (Blažek et al., 2020).

In particular, despite being amongst the most vulnerable and locked-in regions in the world, mining regions in the Global South have received limited attention in current debates on economic geography. These 'locked-in and vulnerable resource-based regions' (LVRRs) (Nilsen et al., 2023) are often seen in Latin America and Africa, and are typically characterised by an enclave economy, which hinders endogenous development (Arias et al., 2014; Haslam & Ary, 2016; Hodler, 2006). While the literature has acknowledged the different structural challenges affecting different types of peripheral regions, as well as the associated opportunities for actors to shape opportunity spaces for regional development, the focus has mainly been on developed countries (e.g., Nilsen et al., 2023; Tödtling & Trippl, 2005). Scholars have thus called for more studies understanding the role of agency in contexts other than high-income countries (Benner, 2023; Grillitsch et al., 2022), a gap that we contribute to addressing in this paper.

Specifically, we focus on the role of universities in initiating or promoting regional development paths in LVRRs in the Global South. Universities are widely regarded as key contributors to regional development (Marques et al., 2019; Pugh et al., 2016; Uyarra, 2010). In peripheral

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regions, they can be an important driver of change as they can partly compensate for the lack of innovative firms and knowledge infrastructure and resources (Nilsen et al., 2023; Pinto et al., 2015) and help address societal challenges afflicting these regions (Henderson et al., 2023). In this context, several Latin American countries have created new science and innovation funds that depend on natural resource revenues, where universities are expected to play a leading role in shaping region-wide projects (Iizuka et al., 2017; Medina-Bueno et al., 2021). Despite this potential, the role of universities as agents of regional change is generally overlooked in the literature on LVRRs (Atienza et al., 2021; Mora et al., 2018).

Building on a comparative case study of two of Peru's main mining regions (Arequipa and Cajamarca), we examine the challenges and opportunities for universities to drive innovation and new path development. Our findings illustrate how contextual preconditions like the climate of social conflict, unequal powers of influence between actors, strong interests in mining rent seeking and the lack of an innovation culture in the regional ecosystem hinder universities' contribution to innovation activities. However, strategic leadership and institutional capacities are central elements that can spur universities to increase their local engagement and promote regional development.

2. REGIONAL CHANGE AGENCY AND NEW PATH DEVELOPMENT IN LOCKED-IN AND VULNERABLE RESOURCE-BASED REGIONS

Seeking to shed light into the heterogeneity of peripheral regions, Nilsen et al. (2023) identified four distinct types, each with its own set of challenges: 'resilient regional service centres'; 'locked-in specialized regions'; 'vulnerable rural regions'; and 'locked-in and vulnerable resource-based regions' (LVRRs). The latter regions are considered vulnerable because they are locked into extracting the value of natural resources and are highly dependent on one (or a few) large companies, often of foreign origin (Arias et al., 2014; Orihuela, 2018). These regions face multiple types of lock-in (Grabher, 1993), such as cognitive lock-in to particular views and narratives associated with a narrow industrial specialisation, political-institutional lock-in due to the dominance of powerful local elites and functional lock-in within production networks (Nilsen et al., 2023). These forms of lock-in become even more acute in the case of mining regions from the Global South. Given the global fragmentation of production, they struggle to attract and anchor high-value activities from extractive industries' global production networks, leading to a vicious circle that hampers the emergence of specialised suppliers, skilled jobs, and knowledge exchange (Atienza et al., 2021; Chen et al., 2020).

However structural factors alone cannot explain why some regions develop new paths while others do not, and this has led to recent scholarly interest on the role of agency in path creation. The importance of local agency has been discussed in concepts such as reproductive or maintenance agency and change agency (Grillitsch & Sotarauta, 2020 Jolly et al., 2020;). While the former is oriented towards stability and resisting change (Bækkelund, 2021; Baumgartinger-Seiringer, 2022), the latter is aimed at 'identifying change strategies and demolishing, renewing, and building new structures' (Jolly et al., 2020, p. 177). Grillitsch and Sotarauta (2020) differentiate three types of change agency, which together conform a *trinity of change agency* contributing to regional transformations: *innovative entrepreneurship*, associated with the introduction of new goods, processes or organisational forms which break with traditional industrial paths; *institutional entrepreneurship*, referred to actions seeking to challenge established norms, establish alternative practices, and enhance legitimacy, in order to unlock new regional paths; and *place-based leadership*, understood as the capacity to develop a vision and a common agenda for regional development, inspiring and mobilising multiple actors for goals that transcend individual interests.

The trinity of change agency is a useful perspective to understand how emerging development paths may be initiated or encouraged, despite disadvantageous local preconditions. For the case of LVRRs, the opportunity space for regional development is very narrow (Nilsen et al., 2023), particularly *in* mining *regions* in *the* Global South. Innovative entrepreneurship is constrained by the hierarchical structure of mining value chains as well as the lack of learning and absorptive capacities of the local business sector, conformed mainly by small and micro enterprises (Atienza et al., 2021). In addition, LVRRs often face high living costs compared to other peripheral regions, making it less attractive for firms from non-mining sectors and for talented individuals to locate in these regions (Measham et al., 2016). The presence of acute poverty, widespread social conflict and political instability hinder improvements in formal and informal institutions that are required to support regional change (Medina-Bueno et al., 2020). The high skewness of power relations impedes overcoming political–institutional lock-ins (Görmar et al., 2023). A small but powerful elite of managers of mining firms and leaders of regional governments promote their vested interests, while citizens accommodate to the relatively stable (but low paid) jobs provided. The prevalence of power groups that seek to capture rents from mining activities tends to widen economic inequalities, while regional governments tend to protect the interests of the dominant mining multinationals (Hodler, 2006). Abundant natural resource rents, high inequalities, and the negative externalities that extractive activities generate in the environment accentuate social conflicts, lack of trust amongst actors and corruption (Haslam & Ary, 2016; Irarrazaval, 2022). Finally, the presence of high dependency on foreign actors, lack of trust amongst agents, and mounting polarisation and social conflict, reduces the opportunities for local policymakers, business leaders and university authorities to engage in place based leadership (Newey & Coenen, 2022).

However, it is important to note that the three categories of agency do not refer to types of actors. Instead,

different actors, such as firms, public policy actors, civil society organisations or universities, may pursue different types of agency simultaneously or at different times and in different contexts (Bækkelund, 2021; Flanagan & Uyarra, 2016). Nor are they restricted to local actors: extra-regional linkages are important for path creation, and non-local actors also have agency which may steer the path in similar or different directions to those wished for by local actors (Bækkelund, 2021). Change agency is also not restricted to new actors. Indeed, Baumgartinger-Seiringer (2022, p. 392) notes that the role of new entrants (new firms, institutional entrepreneurs) has been overemphasised in the literature on change agency, limiting our understanding of how well-established actors may 'drive and suppress regional industrial change'.

In this article we explore how universities, as well-established regional actors, may act to broaden the opportunity space for LVRRs, and the challenges they face in this endeavour. The literature has explored multiple dimensions of the role of universities as change actors in peripheral regions. For instance, they have been portrayed as having the capacity to mitigate the relative absence of innovative activities by providing knowledge intensive services (Pinto et al., 2015) and connecting the region with external sources of knowledge (Guimón & Paraskevopoulou, 2017). Universities in peripheral regions are also depicted as playing a more developmental or 'engaged' role as part of their third mission, including a stronger regional focus seeking to address complex societal challenges (Henderson et al., 2023). These efforts in turn require institutional change at multiple levels, including a need for university leaders to adapt internal governance structures of universities and structures shaping researchers' activities (Kroll & Schubert, 2023) and institutional work to support alignment between universities and community-based actors (Petersen & Kruss, 2021). However, the literature has rarely explored how universities pursue multiple forms of agency at multiple levels, and even less so in the case of LVRRs from the Global South. To this we turn in the following section.

3. UNIVERSITIES AS AGENTS OF REGIONAL TRANSFORMATION: INTERNAL AND EXTERNAL TENSIONS IN THE GLOBAL SOUTH

Given the high dependency on foreign-owned mining companies, the low absorptive capacity and innovative capabilities of local firms and the weakness of regional governments, universities can be regarded as one of the most promising actors to foster socioeconomic development in the Global South. The independence, openness and territorial embeddedness of universities place them in a unique position as agents of regional change by transferring relevant knowledge, promoting human interaction, and building trust and common purpose among diverse stakeholders (Brekke, 2021; Fonseca et al., 2021; Harrison & Turok, 2017). Indeed, universities are key institutions supporting the process of industrial and social development (Yusuf & Nabeshima, 2007). Their priority at the early stages of development is to build basic human capital, but as industrial development proceeds the need for more sophisticated training grows, and so does the need for research efforts to build technological capabilities (Lall, 1992). Beyond universities' traditional missions of teaching and research, their 'third mission' is associated with a closer interaction with other actors in the regional ecosystem through a variety of knowledge exchange and co-creation mechanisms (Goldstein & Renault, 2004; Uyarra, 2010). This encompasses an 'engagement' role, focused on transferring to the non-academic sector (including business and public administration) the technologies and knowledge developed within universities, an 'entrepreneurial' role, fostering new business ventures by academics and students (Guerrero et al., 2015; Sánchez-Barrioluengo & Benneworth, 2019), as well as a 'civic' role, contributing to the social, cultural and environmental development of the territories where universities are located (McKelvey & Zaring, 2018).

While academic debates on university missions tend to focus on developed countries, universities in emerging economies across Africa, Asia and Latin America face different realities in terms of the relative importance of different missions and how they are operationalised in practice (Athreye et al., 2023; Fischer et al., 2021; Misra & Pugh, 2023; Thomas & Pugh, 2020). On these grounds, the seminal contributions of Sutz and colleagues advocated for 'developmental universities' (Arocena et al., 2015; Sutz, 2005) that embrace the broader purpose of instigating socioeconomic development and regional change through the interplay of their three missions and intense collaboration with various stakeholders, rather than merely aiming at a narrow third mission through technology commercialisation and university-business knowledge exchange.

Indeed, universities in peripheral regions from the Global South grabble with significant barriers limiting their transformative potential, including low aggregate R&D investments and limited absorptive capacity of regional firms, scarcity of specialised skills, institutional weaknesses, and ill-developed science-industry linkages (Athreye et al., 2023; Mora et al., 2018; Pinto et al., 2015). In addition to these external factors, the role of universities as change agents is challenged by a variety of internal shortcomings related to financial resources, human capacities, management structures and intrinsic motivations, influenced by higher education policies and institutional path dependencies. Adequate management structures are important not only for preserving a collegial atmosphere but also for navigating continuous change and ensuring alignment with societal needs (Fischer et al., 2021; Kroll & Schubert, 2023; Petersen and Kruss, 2021), requiring more participatory collaborative styles of leadership. Importance of leadership development (Davis et al., 2015). However, as Liu and Huang (2023) note, while large universities in developed countries have experienced increased professionalisation of academic managers, including professional training for administrators and

middle management, systematic leadership development tends to be lacking in less developed contexts.

Regarding human resources, the academic qualifications of university lecturers and researchers in these regions are often limited, with a small fraction holding PhD degrees, hindering the generation of high-impact research. In addition, there is normally a lack of incentive systems for faculty to engage in knowledge exchange activities at regional level, such as incentives in recruitment, remuneration and internal promotion processes (Guimón & Paunov, 2022). Moreover, academics are unprepared to strengthen the entrepreneurial skills of students (Breznitz et al., 2022), not to mention the difficulties of anchoring to the territory the most talented students with potential for starting new businesses (Kitagawa et al., 2022).

Given the challenge of limited skills and capabilities for applied research and knowledge transfer, cooperation with international centres of excellence can be an effective strategy for universities to overcome institutional lock-ins, as illustrated by the historical evolution of successful industrial clusters in Latin America (Guimón & Paraskevopoulou, 2017). But, in the absence of strong leadership, these international linkages are rarely promoted at the highest level and integrated into a genuine process of internal change at universities.

Besides academic staff, universities from peripheral regions in the Global South also suffer from the lack of skilled knowledge transfer intermediaries and technical professionals, which are critical to third mission activities (Hernández-Socha & Zuluaga-Jiménez, 2022). Recent studies have also shown that universities in LVRRs face a shortage of staff with technical and administrative capacities when managing science and innovation funds (Iizuka et al., 2017; Medina-Bueno et al., 2021). This contributes to the 'regional innovation paradox', defined by Oughton et al. (2002) as the greater need of lagging regions to invest in innovation against their relatively lower capacity to absorb funding compared to more advanced regions.

University managers and individual academics have various motivations to engage with their regions, including not only the genuine desire to contribute to regional development, but also to generate new sources of funding for the university and to instigate modern university administrative structures (Benneworth et al., 2017). But, from a multi-task principal-agent perspective (Holmstrom & Milgrom, 1991), the challenge is that agents (university managers and principal researchers) that have to conduct different tasks (or missions) for the principal (regional/national governments) will tend to focus on those that involve less risk and whose results are easier to measure. Confronted with very tight budgets and a strong 'mission overload' (Benneworth et al., 2016), universities in these regions typically prioritise teaching over research or knowledge exchange.

In summary, the demands placed on universities become broader in regions in the Global South, because of the urgency to address pressing challenges such as poverty, inequalities, weak public services and infrastructures, environmental degradation, and social conflict. However, the lack of resources, institutional capacities and internal leadership may impede these universities to fulfil the increasing expectations placed on their contribution to regional development. In light of this, Bonaccorsi (2016) cautions against holding exaggerated expectations on the role of universities in peripheral regions and the dangers of uncritically applying models from more developed regions without adaptation to local contexts.

4. CONTEXT AND EMPIRICAL APPROACH

4.1. The context

With a population of around 33 million, Peru has been one of the fastest growing economies in Latin America over the last decade. But acute social and economic challenges persist, including poverty, inequality and limited access to education and healthcare. The mining sector accounts for around 10% of the country's GDP and over 60% of its exports. Social and ethnic conflict is a recurring challenge due to disparities in wealth distribution, particularly in relation to land rights and resource extraction. This has led to frequent protests and violent clashes between indigenous communities, mining companies and the government. The country has suffered from strong political instability in recent years. With six different Presidents from 2016 to 2022, including three who were imprisoned for crimes committed during their time in office, this political instability has exacerbated social discontent. Poverty, inequality, corruption, and political instability have led to the rise of populist movements and social conflict, both at national and regional level, echoing what Rodríguez-Pose (2018) has referred to as 'the revenge of the places that don't matter'.

Our research draws on a comparative case study of two of Peru´s most important mining regions: Cajamarca and Arequipa. The former is specialised in gold and the latter in copper production. Both Cajamarca and Arequipa, located in the South and North of Peru respectively (Figure 1), have around 1.5 million inhabitants, but Arequipa is clearly more prosperous than Cajamarca (see Table 1). Arequipa is the second largest regional economy among Peru's 24 regions, with a 6.5% share in national GDP, while the traditionally less developed Cajamarca region accounts for 2.3% and is the ninth largest regional economy (Table 2). Arequipa represents around 24% of the country's total production of copper. Its Cerro Verde mine is one of the largest copper mines in the world. The region is also rich in gold, silver and zinc deposits. The region of Cajamarca, located in the northern highlands of Peru, is known for its large gold deposits, including the Yanacocha mine, among the largest gold mines in the world. Cajamarca represents around 30% of Peru's total gold production and is also home to significant copper and silver deposits. Despite its richness of natural resources, Cajamarca suffers from high levels of poverty, with many rural areas lacking access to basic services

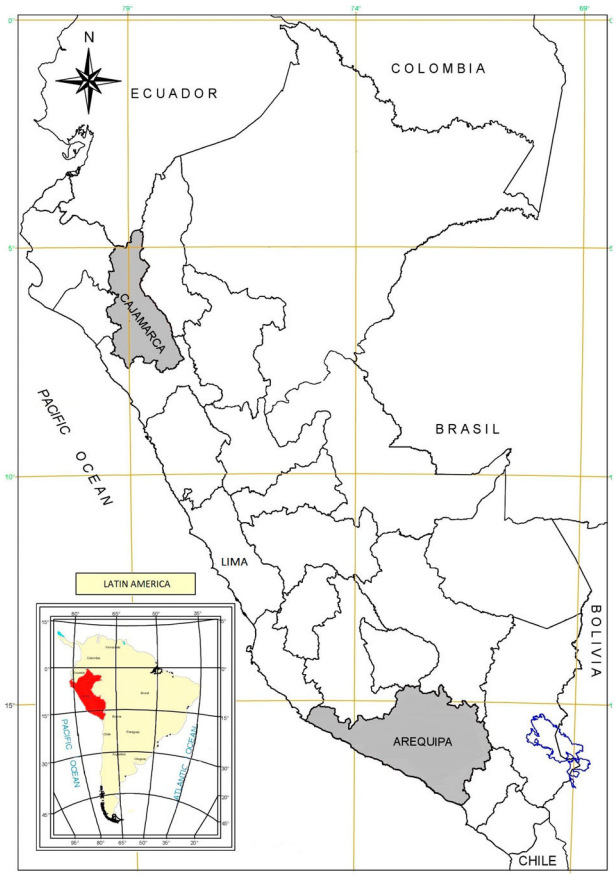

Figure 1. Map of Peru and the regions of Arequipa and Cajamarca.

such as electricity and clean water. Both regions face increasing concerns about the environmental impact of mining activities, particularly regarding water resources and the health of local communities. While Cajamarca and Arequipa are archetypical examples of LVRRs described in Section 2, the latter exhibits higher living standards and benefits from higher quality institutions,

Table 1. Key characteristics of Cajamarca and Arequipa.

	Perú	Cajamarca	Arequipa
Population, 2021 (million)	33.03	1.45	1.52
Rural population, 2021 (%)	17.6	64.6	8.2
Gross Domestic Product (GDP) per capita, 2021 (USD)	6724	3465	7960
Average annual GDP growth, 2007–21 (%)	7.4	6.5	7.6
Share of mining sector in GDP, 2015–21 (%)	9.8	22.6	24.1
Illiteracy rate, 2021 (%)	5.2	10.4	3.0
Poverty rate, 2021 (%)	25.9	40.9	13.9

Source: Own elaboration based on the Regional Information System 2022 of the National Institute of Statistics and Information of Peru (INEI).

Table 2. Research capacity of UNC (Cajamarca) and UNSA (Arequipa).

Region	UNC	UNSA
Total number of publications in Scopus journals (2015-21)	102	1141
Total number of patent applications (2015-21)	0	43
Total number of research projects implemented (2015-20)	18	65
Accredited researchers per 10,000 students (2021)	16	34
Lecturers with doctoral degree per 10,000 students (2021)	98	149

Source: Own elaboration based on RED IDI (2019) and official reports from CONCYTEC, UNSA, UNC and Publisher Elsevier (2022).

more advanced governance systems, and more inclusive policies (Barrantes et al., 2012).

4.2. The university system

The Peruvian university system consists mainly of public universities, which have operational autonomy and are financially dependent on the central government, alongside some private universities. There is a higher concentration of universities in central regions such as Lima (Peru's capital), where the largest share of science and innovation efforts prevail, compared to the country's peripheral regions. However, in recent years the Peruvian government has been providing its regional public universities with increased financial resources from mining royalties to boost science and innovation. In 2003 the government created the Mining Canon Fund,[1] focused on providing new funding to mining regions to develop science and innovation projects (Pebe et al., 2017). Cajamarca and Arequipa are among the five regions that have received the largest volume of funds from the Mining Canon, which has become the main financial source for investments in science and innovation projects. The public universities of both regions have jointly received more than USD 160 million from this fund between 2004 and 2021, representing over 70% of their total budget for research activities (MEF, 2022). However, these resources were hardly used and were accumulated year after year until 2015 when the expenditure really kicked off.

As recipients of Mining Canon funds, public universities in Peru's mining regions are increasingly expected to act as regional change agents and foster regional development. Arequipa has one public university: the National University of San Agustín of Arequipa (UNSA), located in the city of Arequipa. Since its foundation in 1828, UNSA has become one of the leading public universities in the country. With around 29,000 students enrolled, the university is large by Peruvian standards. Cajamarca has three public universities: the National University of Cajamarca (UNC), the National University of Jaén (UNJ) and the National Autonomous University of Chota (UNACH). The UNC is the oldest and largest university in the region, founded in 1962 and based in the city of

Cajamarca. It accounts for more than 56% of the total number of students enrolled in public and private universities in the region (around 12,000). The UNJ and UNACH are smaller universities created recently (in 2008 and 2010, respectively) and have very limited research activities. For these reasons, in the rest of this study we will focus on the UNC for the case of Cajamarca.

Table 2 presents the scientific production (publications and patents) of UNSA and UNC. UNC has increased the scientific production in 40.2%, from 5 publications in 2015–38 in 2021. The increment for UNSA has been 47.1% (from 31 to 314 in the same period). Likewise, between 2015 and 2021, UNSA generated 43 patent applications and the UNC did not obtain any. It should be noted that the level of scientific production at UNSA is relevant and competitive compared to other leading universities in the country. For example, between 2015 and 2021, the Universidad Nacional Mayor de San Marcos (UNMS) and the Pontificia Universidad Católica del Perú (PUCP), which are the two main universities in the capital (Lima), and which do not receive funds from Canon Mining, have achieved a total of only 20 and 26 patent applications, respectively. Regarding publications, UNMS achieved 3370 and PUCP 3261.

4.3. Methodology

The empirical inquiry focuses on analysing the different internal and external conditions that enabled or hindered the transformative role of universities in Cajamarca and Arequipa during the period 2015–2021. These regions strike the right balance between contrast and comparability, with similar challenges and backgrounds but some variation in the relevant characteristics of their universities and their surrounding ecosystems, thus offering a suitable setting for a comparative case study (Eisenhardt, 1989). As discussed earlier, both regions are amongst the main recipients of Peru's Mining Canon Fund for science and innovation since 2003, but it was not until 2015 when the expenditure kicked off. In addition, both UNC and UNSA underwent leadership transitions (elections of rectors and vice-rectors) in the same year, 2015, following the enactment of a new university law in Peru the preceding year.[2] However, there are also significant differences between the preconditions of these regions, in terms of their level of development, the quality of their institutions, and the potential of their universities (Barrantes et al., 2012).

Although the case study method is subject to limitations related to subjectivity, lack of generalisation, and conscious and unconscious biases (Diefenbach, 2008), it is appropriate for exploratory analyses of emerging and complex phenomena (Yin, 2013) and may contribute towards theory development (Eisenhardt, 1989).

We relied on multiple sources of data, including documents and primary data from 26 semi-structured personal interviews. To enhance the validity of the study through triangulation (Yin, 2013), we interviewed four categories of stakeholders: (i) university authorities; (ii) academics and experts with knowledge of the regional innovation ecosystem; (iii) high-level public officials responsible for regional science and innovation policies and (iv) representatives of private firms and associations involved in regional innovation initiatives (see Table A.1 in the online supplemental data). The interviews lasted one hour on average and were conducted in three phases: the first, face-to-face, between December 2019 and February 2020; the second, via videoconference and telephone, between January and April 2021; and the third, face-to-face and videoconference, between October 2022 and February 2023. We interviewed some of our informants twice to obtain more dynamic information and to follow up on aspects of interest.

The data collected from interviews was supplemented with secondary sources, such as official documents and websites from universities and regional and national governments. Specifically, we looked at several types of documents such as: (i) universities' strategic plans and management reports; (ii) accountability reports; (iii) management instruments, such as the Organisation and Functions Manual, the Personnel Analytical Budget, and the Single Text of Administrative Procedures; (iv) Plans and Policies documents, such as the Institutional Operating Plan and Strategic Operating Plan and (v) internal agreements and regulations. We also looked into the CVs of university managers, to assess their research, leadership and international experience.

5. RESULTS

5.1. The National University of Cajamarca (UNC): institutional inertia and limited place-based leadership

In 2015 a new University Council (democratically elected authority) became responsible for running the UNC, headed by a new rector (over 60 years old) and two new vice-rectors, all of them men. The new rector, a public accountant professor, had extensive experience in university management including a previous mandate as rector between 2004–2009. Both the vice-rector for research and the academic vice-rector were engineers. The former had completed postgraduate studies abroad while the latter had pursued them locally, and both of them had focussed their careers on teaching rather than research.

Critics argued that this candidacy represented a continuation of the *status quo*: '*the rector won despite the existence of a new option, but without a vision or relevant proposals for reforms*', said an academic in one of our interviews. The lack of leadership skills was aggravated by insufficient experience in managing research and third mission activities: '*the elected authorities may be good chemists, physicists or doctors, but they have been lousy leaders and public managers*'. As one senior public official pointed out:

> The authorities were afraid of 'messing up' and being sanctioned […] But this was due to the inexperience in management and lack of vision and university perspective that characterised them […] They were not interested in

> research; they had no vision and did not assume the role of an entrepreneurial university committed to the region.

The university's regional engagement was hampered by other internal factors, such as the lack of an organisational and cooperation culture fostering the development of collective learning, information exchange and collaboration between the university and non-academic actors. Knowledge generation and exchange also requires significant technical capacities, but the university was perceived to lack the needed researchers and framework conditions (e.g., knowledge transfer offices, laboratories, equipment, system/individual incentives). As of 2020, according to the Peruvian National Council of Science and Technology, only 16 out of the more than 600 appointed professors at the UNC were recognised research professors,[3] and most of them did not hold a doctoral degree. According to private sector representatives:

> The little research that has been done is basic and was not linked to the real potential and needs of the region […] We believed that the university could support us with applied research and offer business development services. However, when we asked the university for support, we realised that they did not have the required capabilities.
> […]when we started working with mango, grape and avocado producers in the Jequetepeque Valley, we needed professionals from the university who knew about these issues, but we couldn't even find one. We had to bring in professionals from other regions of the country.

The adoption of the Mining Canon Fund took longer than expected partly due to the change of senior leadership team in 2015 and the delay in the implementation from the vice-rectorate for research. No awards were made in the first submissions of R&D projects in 2017 mainly due to the low participation and low quality of the applications. In 2018, two new calls for proposals were launched where a total of 15 projects were funded in the areas of health, education, and agriculture, with an overall budget of around USD 2.5 million. Several interviewees argued that low participation levels in the Mining Canon Fund was due to the absence of direct financial benefits for researchers. The fund mainly provided indirect incentives like training and opportunities to attend scientific conferences.

The university did not put in place a strategy for regional engagement, including priorities and actions for engaging with the regional ecosystem. This, combined with weak internal management, increasing the skewness of power towards vested interests. This is illustrated by the following quotes from some academics:

> Regional research and development policies, plans or instruments at the UNC have often been designed and implemented based on specific and very closed lobbies or interest groups within the university, neglecting broader interests and critical assessment of real regional priorities in need of action.

> Progress in university research and innovation was also aggravated by the prevalence of bureaucratic, rigid, closed and non-transparent administrative processes. Low financial rewards also complicated this.

In addition, a persistent climate of conflict in mining areas was identified as a significant barrier to university-industry interactions. The atmosphere of conflict created a sense of distrust and hampered the development of relationships between different actors. As expressed by senior government officials:

> In Cajamarca and other mining regions, since the 1990s, there has been an increasing social polarisation around mining activities […] The constant environmental pollution of the mining sector, the poor response and high corruption of sub-national governments, the unequal redistribution of mining revenues, and the lack of credibility of the academic sector, have generated a lot of distrust and social conflict in the area.
> Mining activity has been stigmatized. There is the controversial slogan 'water yes, mining no' that has generated a division amongst actors: those who are in favour of mining, and those who are against it. […] This has also led to a division amongst authorities, professors and students within the university regarding the role that it should assume with respect to mining and regional development […] and a prevalence of particular interests within the university. This has limited the impulse of joint initiatives inside and outside the university.

More generally, the regional business sector's insufficient absorptive capacity hindered the university's ability to contribute to regional development. An academic argued that:

> Both the prevalence of micro and informal enterprises and the low interest of public universities prevented the generation of collaborative arrangements for innovation. In addition, the high birth and death rates of small and medium-sized enterprises, largely specialised in generic and routine mining-related tasks (service providers) and the lack of skilled labour markets in the region severely limit university-enterprise linkages.

The large companies in the region (8% of the total), primarily operating in the mining sector (BCRP, 2019), also showed no interest in participating in joint regional science and innovation initiatives. For example, in 2019, when the central government promoted the creation of the Regional Development Agency of Cajamarca, neither large companies nor the university participated in this initiative. Mining companies develop their extractive operations far from urban agglomerations and are headquartered in Lima or outside the country, which, according to our interviews, limits their interaction with the university, local businesses, and even the local government. This is aggravated by the lack of legal conditions and incentives for companies in general to invest in R&D. '*In Peru there is an excess of regulations and an inability to enforce the rules, as*

well as few tax incentives for those who want to promote science and innovation', said a national representative of the mining sector.

In 2021, while the university sector continued to experience the above-mentioned challenges, interviewees identified some favourable developments. Among these, the creation of special committees with experienced external evaluators improved the evaluation processes for science and innovation projects; administrative processes were streamlined by creating an administrative committee with managers from different internal administrative areas; and most professors were able to obtain a master's degree and even started their doctoral studies. The new university authorities elected at the end of 2021 bring new hope, since they are seen as less political and more visionary, technically capable, and committed to instigating change within the university and the region.

5.2. The University of Arequipa (UNSA): towards an increasing role in regional change and new path development

The UNSA faced similar difficulties from Cajamarca, until the mind-2010s. However, this situation began to improve in 2015, with a change in the university senior leadership team. That year, a new rector and two vice-rectors were put in charge of designing and implementing a strategic development plan that prioritised research and innovation, placing it at the forefront of their agenda, and adopted a global university approach. Although the new team did not, according to our interviewees, have much management experience, they had the vision, leadership, and political willingness to promote reforms that would improve policies and incentives for the generation and exchange of knowledge. The new rector was a relatively young university professor (50 years old), trained as Public Accountant and with extensive experience in management in the private sector. The vice-rector for research was an engineer with postgraduate studies abroad and international reputation as researcher. And the position of academic vice-rector for the first time been held by a woman.

Boosting science and innovation at the university also required the direct support of a middle management team (deans and directors). However, most of them had difficulties in leading and managing science and innovation projects. Overcoming these limitations required significant efforts to mobilise financial resources and to train authorities in international centres of excellence:

> We had to design and agree on a training plan […] In the end, some deans were trained at the Institute for the Management of University Leaders at the University of Santa Catarina, in Brazil […] Others have gone to other countries, depending on their specialities, such as Spain, Mexico, the United States, Canada, Chile and Argentina. The training had different phases and lasted two years […] This provided us with a lot of knowledge on how to lead, manage and implement science and innovation initiatives.

The clear vision by UNSA authorities began to improve operational processes and, at the same time, strengthen internal technical capacities. For example, a logistics-administrative area with specialised staff was created specifically to manage research, entrepreneurship and innovation issues, achieving more efficient and coordinated processes. An all-year-round submission window for research projects was also implemented, which led UNSA to speed up, simplify and increase the number of research proposals in general. Finally, control and monitoring mechanisms were strengthened for greater transparency and accountability. This allowed releasing funds more effectively than in the case of Cajamarca. In 2015, a total of more than USD 55 million from UNSA's Mining Canon remained unspent. In 2016, at the rector's request, an agreement was signed with the Peruvian National Council of Science and Technology which transferred the responsibility for the management of the science and innovation projects financed by the Mining Canon to the Council. As a high-level public official argued:

> The implementation of this agreement not only resulted in better use of the Fund but also in an increase in the research capacities of the professors […] Although this agreement only lasted one year, it was enough for UNSA to learn the whole management process.

UNSA authorities also established links with foreign universities to accelerate the development of faculty skills and increase R&D projects. For example, in 2017 UNSA signed an agreement with Purdue University (USA) to develop 21 research projects, with a budget of over USD 15 million. These projects aimed to address critical environmental and sustainability issues in the region. Shortly afterwards, agreements were signed with the Colorado School of Mines (USA) and the University of Oklahoma (USA) for a series of joint research projects on artisanal mining and climate change issues, respectively.

UNSA and Purdue University also established an alliance (at the end of 2017) to create the first science and technology park in Peru, which allocated USD 67 million from the Mining Canon Fund. Forty laboratories were built as a result, leveraging existing capacities to develop research in strategic areas such as metallurgy, environmental biotechnology, biomining, nanomaterials and hydraulics, among others. These laboratories also sought to foster technology transfer and provide technical assistance and support to firms in the region. Their creation represents '*a fundamental advance and a favourable environment to develop science and innovation initiatives with regional impact*', according to a university authority.

The development of international networks led to changes in the way research was performed, as many traditional professors '*began to do internships, participate in scientific conferences and develop joint research with younger researchers*', according to university authorities. This also led to a renewal of numerous teaching staff, recruitment of external researchers, promotion of many, mainly young, academics, and training for research groups with

foreign researchers, among other initiatives. In addition, this new research environment and dynamics motivated many academics and students to get involved in various science and innovation projects.

As a result, at the end of 2019, UNSA received the Excellence Award, granted by the scientific publisher Elsevier and the National Council of Science and Technology, for achieving the highest number of publications in Scopus at the regional level in Peru (RED IDI, 2019). Likewise, it ranked first nationally among public universities in terms of patent applications and graduate students publishing articles in internationally indexed journals. '*While these advances are very few if compared internationally, at the national level they are significant*', commented one interviewee.

In addition, some research groups began to show concrete results of knowledge transfer for regional development, in some cases triggered by external events such as the COVID pandemic. For example, one academic commented as follows:

> During the COVID-19 pandemic, UNSA developed a prototype of a low-cost encapsulated videolaryngoscope that allows performing the intubation manoeuvre on the patient with more precision and effectiveness, and less exposure for doctors […] The equipment was donated to different hospitals in the southern macro region of the country to help tackle the coronavirus.

University-business collaborative initiatives were enhanced. For example, the business incubator JAKU – a Quechua word meaning 'let's go' – was created and accredited to provide specialised advice in various areas to entrepreneurs and companies at an early stage of growth. In recent years, JAKU has created and launched more than 25 start-ups, many of which are owned by students. In 2019, JAKU, with the support of the Peruvian Ministry of Production, launched a competition to finance innovative entrepreneurial ideas in the entire southern macro region of the country, which managed to recruit 167 teams, reaching a record number of projects.

However, university knowledge exchange is still limited and faces various barriers. Among these, the lack of a coherent regional innovation policy was repeatedly mentioned by our interviewees. The UNSA authorities made progress by designing a university science and innovation strategy with shared objectives and vision, but its incomplete implementation highlights the need for integration into a broader regional innovation policy and research agenda, with input from all regional stakeholders. Regional engagement is constrained by a weak university representation in the region and the lack of interest shown by regional actors in interacting with the university.

Particularly, the level of collaboration between the university and the business sector in the region is still low due to a highly fragmented productive structure and the weak anchoring of large firms in the region (24% of the total), especially in the mining sector. Furthermore, there is a lack of culture of collaborative problem-solving, and even a distrust towards universities and their relevance to business development. '*The large mining companies told us that if they needed any research and innovation, they would seek it out and do it internationally*', said one university official. Likewise, one academic bluntly stated:

> On the one hand, there is self-centredness in the micro-entrepreneurial sector considering that universities cannot transfer knowledge to entrepreneurs because they believe that academics are only theoreticians and are distanced from reality, which is a myth. On the other hand, microentrepreneurs and the population, in general, believe that R&D is an unnecessary expense. This mental model is a major problem that limits innovation and knowledge transfer across the business sector.

To address these challenges, UNSA began to develop links with local companies, albeit on a small scale and more dependent on the enthusiasm of researchers. Likewise, thanks to the implementation of the technology park and an Office of Development and Entrepreneurship, UNSA has expanded its links with the rest of the actors in the territory. These activities are central to enhancing the capabilities of local SMEs and their capacity to integrate into the supply chains of large mining companies operating in the region.

However, at the end of 2021 the challenge lied in continuing the various R&D initiatives and improving the exchange of knowledge for the economic and social development of the region. Indeed, although the embeddedness of UNSA in Arequipa is clearly stronger than the case of Cajamarca, many challenges remain, and despite the promising developments during 2015–2021, it is still to be seen whether the university can really become a transformative agent. The new university authorities elected in late 2021 represent a continuation of the promising developments outlined above, with a new management team composed by accredited researchers, with managerial positions in previous administrations and management experience related to the internationalisation of the university.

5.3. Key challenges for universities to become transformative agents

The two regions illustrate the challenges of regional path creation in LVRRs, highlighting their situation of vulnerability and lock-in, and therefore the relative narrow opportunity space for regional development. Innovative entrepreneurship is necessary to explore opportunities away from existing specialisations but is challenging given hierarchical structures, high dependency of foreign actors and lack of absorptive capacity of local businesses. Institutional entrepreneurship and place-based leadership to support local communities in the development of alternative economic trajectories are also hindered by political instability, social conflict, and highly skewed power relations.

In this context, we analysed whether and how universities act as agents of change in Cajamarca and Arequipa.

In the case of Arequipa, change in internal leadership of the university was a key factor in unlocking various administrative, technical and institutional barriers, compared to the difficulties faced by Cajamarca. Indeed, the administrative, research and international experience of the university senior leadership contrasts with the case of Cajamarca. Interestingly, university leaders in Arequipa managed to link their international background and connections while maintaining sensitivity to the local context (Liu & Huang, 2023), leveraging research activities to deal with regional societal problems (Kroll & Schubert, 2023).

They also demonstrated strong awareness and eagerness to push reforms towards a shared agenda for regional development, striving to build trust and credibility, and mobilising multiple actors towards a more strategic vision for the university and the region. In addition to a younger rector, for the first time a woman became part of the senior management team, signalling broader commitment to gender equality and diversity. during the period analysed, women constituted around a third of university leadership roles, compared to less than twenty percent in Cajamarca, with no female senior managers. In addition, the university authorities elected in 2015 in Cajamarca fell short in the leadership and capabilities needed to enact transformative change. Despite leadership change, the university kept core practices unchanged, maintaining the status quo and constraining opportunities for place-based leadership, institutional change, and innovative entrepreneurship.

In both cases, excessive bureaucracy, lack of incentives for researchers, and lack of technical personnel with specialised knowledge transfer skills were critical internal challenges hindering knowledge generation and exchange. While the substantial additional funding for research received by both universities through the Mining Canon Fund during the period analysed represented a critical juncture, its application was particularly challenging in Cajamarca. This aligns with the regional innovation paradox mentioned in Section 3, which implies that while lagging regions have a greater need for R&D investment, they often face significant challenges in utilising these funds effectively (Oughton et al., 2002). In Arequipa, by change, administrative processes were streamlined and improvements in the management of the Canon Fund led to an increase in both the quantity and quality of submitted research projects. UNSA's actions led to a more dynamic research environment, with traditional professors collaborating with younger researchers and increasing their participation in innovation.

A better use of funds in Arequipa led to an increase in collaborative projects with the private sector, patenting activity, and academic entrepreneurship, accompanied by the creation of a new science and technology park within the university premises. In addition, student entrepreneurship through the creation of start-ups gained recognition and support. These are some promising first steps towards unleashing innovative entrepreneurship in the region, where universities take the lead on knowledge exchange activities surpassing the lack of a strong productive sector. This is consistent with Petersen and Kruss (2021) argument on how the university may act as a change agent that aligns with locally-embedded institutions and practices to promote collective agency.

Moreover, and spearheaded by the strategic direction of its university leadership, the university of Arequipa has established links with international universities and research centres that led to joint R&D projects. These efforts were targeted at solving specific problems related to environmental sustainability and mining management. International linkages became key to strengthening local research capacities and facilitating the absorption of foreign knowledge. In contrast, the university of Cajamarca remains uncapable of engaging in place-based leadership, through improving regional institutional links and international connections.

In line with Fischer et al. (2021), our results point to the importance of internal leadership at the highest level, including rectors and their management teams, as well as middle management levels (e.g., deans, department directors, leaders of research groups/institutes). This helped legitimise activities seeking to, among other objectives, support entrepreneurial activities beyond the dominant sectors, promote research activities to address local societal challenges, engage with regional business communities and attract external knowledge. All in all, this allowed untapping key elements to ignite regional change (see Table 3 with a summary of main results). But, even in the more successful case of Arequipa, it is still too early to evaluate success and to establish a causality between the emerging third mission of universities and regional development outcomes. Even if the internal conditions improve, university place-based leadership would need to be unlocked and accompanied by progress in the external environment, including broader institutional and governance frameworks (higher education policies, science and innovation policies, and industrial policies), as well as the dynamics of the business sector.

6. CONCLUSIONS

This paper responds to recent calls to explore the challenges of left-behind regions in the Global South, focusing on the role of universities as change agents.

Building on the regional change agency approach, we identify the combination of key factors and contextual preconditions for universities to fulfil their local engagement role in a particularly challenging environment. We contribute to recent theoretical debates on developmental universities in peripheral regions from the Global South, with a specific focus on the role of leadership. Empirically, we expand the collection of available case studies with a unique perspective on LVRRs, a subset of hyper-peripheral regions that has been largely overlooked in recent economic geography research.

We highlight the role of university leadership in driving regional change against a lack of political impetus and a weak innovation ecosystem. The contextual preconditions of LVRRs, in terms of their surrounding business and innovation ecosystem, pose a clear challenge to

Table 3. Universities as agents of change in Arequipa and Cajamarca.

	Arequipa	Cajamarca
Regional preconditions		
Social structure	Poverty, inequality, social conflict	Poverty, inequality, social conflict
Poverty	Medium	High
Main industry specialisation	Copper mining	Gold mining
Higher education	Scarcity of specialised skills	Scarcity of specialised skills
Research activities	Increasing scientific publications and patents	Low scientific publications and no patents
Science industry links	Ill-developed	Ill-developed
Institutions	Political instability, corruption, lock-in, lack of trust	Political instability, corruption, lock-in, lack of trust
Universities as change agents		
Internal leadership	Strong vision and strategic planning	Continuity of status quo
Gender equality and diversity	Promoted	Absent
Research and framework conditions	Improvement of operational processes and internal technical capacities. Increased internationalisation.	Lack of technical capacities for knowledge exchange. Insufficient collaborative culture, both internally and internationally.
Innovation	Establishment of science and technology park, and dedicated entrepreneurship support.	Insufficient efforts to improve conditions and incentives for innovation for non-incumbent firms.
Institutional linkages	Emerging efforts to integrate strategy into a broader regional innovation policy.	Lack of coherent regional innovation policies.
Local engagement	Increasingly impactful and strategic engagement with regional actors.	Lack of strategic regional engagement. Distrust from regional actors.
Summary of change agency	*Innovative entrepreneurship* efforts to establish international links and support for entrepreneurship. *Institutional entrepreneurship* efforts to legitimise activities beyond resource-based industries and change culture. *Place-based leadership* efforts to engage locally with institutions and the industry base.	Role closer to *reproductive agency*, with insufficient efforts to change internal processes (including incentives and regulations), engage with the regional ecosystem, and shift industry structures. Recent favourable developments including administrative changes favouring collaborative research, and new leadership team with stronger vision and skills.

universities' ability to deploy their third mission effectively. The dominant large mining companies, with decision-making centres located abroad, tend to act as enclaves and neglect local universities as potential partners in knowledge generation and exchange. This, coupled with the weak innovation performance of local firms, hinders the emergence of more intense university-industry cooperation.

We find that universities can play a critical mediating role to catalyse regional change and to deal with the climate of social conflict and polarisation that characterises LVRRs in the Global South. Specifically, we find that the promotion of university agency through its internal organisation, culture and leadership were necessary to overcome tensions and fulfil the rising expectations placed on universities as central agents of regional change (Harrison & Turok, 2017).

However, our study also illustrates the difficulties in securing the vision, buy-in and leadership for these types of initiatives. For instance, it draws attention to the importance of leadership development (Liu & Huang, 2023) and the risks of lock-in associated with the systems in place for electing university authorities, which may lead to a prevalence of political interests and risk-adverse leaders that tend to cater to short-term demands of faculty and students, rather than adopting a more adaptive, strategic and systemic approach (Davis et al., 2015). In Peru, university leadership election processes[4] tend to result in leaders who are skilled political operators, but may lack the vision and the higher education management expertise that these complex institutions need to fulfil their academic missions.

The findings also underscore a need to refine funding mechanisms such as the Mining Canon Fund, improving the oversight and support from the national government to recipient regions and universities, as well as the internal practices of universities themselves to allocate the funds more efficiently. Regions that have been less successful

in using this new fund, such as Cajamarca, could learn from the experience of more advanced regions such as Arequipa, which as we have seen has introduced good practices to streamline the use of those funds to improve the capacity of its university to address regional challenges. The reform process should also be inspired by international best practices, such as European regional cohesion policies and smart specialisation strategies. While in recent years there has been some debate around the reform of the Mining Canon Fund (e.g., Dargent & Chávez, 2016), with proposals to modify its utilisation, none have prospered, partly due to political interests and insufficient attention from legislative authorities and the universities (Minería y Energía, 2022; SNMPE, 2021).

Our study is not exempt of limitations. First, the study is not able to properly assess the impact on regional change in the mid-/long-term as some of the changes implemented in the case of Arequipa are relatively recent. Second, the involvement of private companies in the study is limited and future studies could map a broader diversity of stakeholders involved in the innovation ecosystem. This opens a promising avenue for future research, focussing on the interaction between different types of regional preconditions, change agency and external events (Grillitsch et al., 2022; Rekers & Stihl, 2021), in the context of peripheral regions in developing countries.

6.1. Ethics statement

The research project was designed to ensure that all ethical considerations were considered during the entire research process, in terms of: (1) *Informed consent*: All participants were informed in advance of the research objectives, procedures and their rights as participants, including the voluntary nature of participation and the freedom to withdraw from it at any time. Interviews were recorded with the consent of the participants and transcribed by the authors; (2) *Anonymity*: Identities of informants were anonymised and personal information that could identify the participant kept confidential; (3) *Confidentiality*: All data collected during the research process was be kept confidential and was only accessible to the research team. Any identifying information collected was kept separate from the research data and not shared with anyone and (4) *Data protection*: Data was stored securely, and measures were taken to prevent unauthorised access or disclosure.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

NOTES

1. The Mining Canon Fund (Law No. 27506) is made up of 50% of the income tax that mining companies pay to the State for the economic exploitation of mining resources (metallic and non-metallic). This percentage is distributed to regional and local governments and universities in the regions where the mining resources are exploited. Of the total distributed in each region, at least 5% must be assigned to public universities in that same region.
2. Law No. 30220 (2014) establishes the normative framework that regulates and controls the quality of the Peruvian university system.
3. Since 2018, this Council has created the National Registry of Science, Technology and Technological Innovation – RENACYT, to regulate and register people and institutions dedicated to research in Peru.
4. With the current University Law in Peru, university leaders (from rectors to deans) are elected from one list by weighted, mandatory voting of all registered professors and students. Professors have two thirds of the vote and students one third. In addition, there are two governing bodies: The University Assembly and the University Council, which are also elected by mandatory and secret vote.

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