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# Innovation in an unfavorable context: Local mining suppliers in Peru

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ABSTRACT

Recent changes in the mining industry have opened new opportunities for technological upgrading by local suppliers in developing countries. This paper explores the factors that foster or hinder innovation in such a context. We employ a case study methodology to analyze a sample of Peruvian mining contractors that integrated into knowledge-intensive stages of the value chain in recent years. Our main findings reveal that technological efforts are largely driven by the mining companies' demands, which favor incumbent over emergent suppliers due to their experience in the local market. In order to integrate into the more knowledge-intensive stages of the value chain, we identified that these firms followed two strategies: (i) identification of local-specific market niches where foreign competition is scarce, and (ii) partnerships with global suppliers and specialization in high-quality and customized complementary services. Still, all the suppliers in the sample are very new in technologically complex activities, and their innovations remain limited from a global perspective. Our findings suggest that this is partly due to a weak institutional setting, scarce support from external organizations, and limited coordination channels in the sector.

## 1. Introduction

During the last decades, Natural Resource Industries (NRIs) have experienced huge transformations, increasingly becoming more innovative and specialized. Specifically, new historical circumstances and recent changes in global markets, technology, and institutions are opening new opportunities for the development of local suppliers and linkages with a high potential for technological diversification (Marin et al., 2015). Regarding mining, Urzúa (2012) argues that the sector's model of production has shifted from the traditional "enclave" system to a highly disintegrated one, where key services along the production chain are being outsourced to independent firms. Considering that mining activity has a heavy weight in the economic activities of many developing countries, there is an increasing interest in the emergence of knowledge-intensive and diversified local suppliers, as they may provide technological solutions that enhance the competitiveness of this industry, both at the local and international levels (Bravo-Ortega and Muñoz, 2015).

For relatively small firms in developing countries, integrating into the more knowledge-intensive stages of the value chain is particularly important because it allows them to access global markets and new sources of knowledge, with potential spillovers for the local economies (Giuliani et al., 2005). The existing literature argues that attention should be paid to how governance patters in global value chains influence innovation efforts among local firms in developing countries. Due to the differences in size and capabilities that characterize firm linkages in such contexts, opportunities for upgrading are highly dependent on the value chain leaders' strategies (Humphrey and Schmitz, 2002; Gereffi et al., 2005). However, some recent studies have stressed the importance of a firm's own learning trajectory and institutional setting over its possibilities for engaging in technologically complex relationships with larger companies (Morrison et al., 2008; Pietrobelli and Rabellotti, 2011). According to their authors, both external and internal factors should be considered as dynamic and mutually dependent forces in order to understand upgrading patterns in developing countries.

The aim of this study is precisely to explore how the dynamics in this industry and the development of technological capabilities influenced innovation efforts among local mining suppliers in a developing economy, thus allowing for their integration into more knowledge-intensive stages of the value chain. Therefore, we focus on the case of Peru, a middle-income country that is highly dependent on mining activities. We base our analysis on the study of a sample of the most innovative suppliers in the country, which were identified after consulting with important mining companies and industry experts. Specifically, we conducted detailed interviews with each of the selected firms, which allowed us to gather information on how they built the skills required to engage in innovation efforts, as well as the role that their relationships with larger actors in the global value chain had in this process. Additionally, we included two research and educational institutions in our sample, in order to understand the influence of the external sources of knowledge and human capital on these firms'

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technological trajectories.

Our research revealed that opportunities for upgrading among local suppliers are largely driven by the mining companies' demands. Since these firms typically value international reputation and expect a high degree of technological capabilities, local firms face important barriers to have their innovations valued and compete with the standard suppliers in the global value chain. However, recent trends in the mining industry have opened important learning and upgrading opportunities for local suppliers. The cases we studied provide evidence that a small group of incumbents has been able to achieve innovations in recent years and use that to expand their markets. These firms benefitted from their experience and contacts in the local market, which favored them over less developed emerging suppliers. Still, we found that the suppliers in our sample followed different strategies to integrate into the more knowledge-intensive stages of the value chain. While a first group of suppliers focused on developing novel products that provided solutions to very specific and rather unattended needs in the local market, the remaining firms benefitted from partnerships with global mining suppliers and specialized in providing high-quality and customized complementary services.

These findings suggest that the direction and scope of the innovation efforts by local mining suppliers depend on their upgrading strategies. Whereas firms specializing in providing competitive complementary services tend to achieve incremental technological improvements, radical innovations are more likely to occur among suppliers focusing on a very specific market niche. Still, all these firms are very new in knowledge-intensive activities, and the scope of their innovations remains limited from a global perspective. According to our research, this may be partly due to a weak institutional setting and scarce support from external organizations (i.e., government, educational and research centers, among others). Furthermore, mining suppliers have no coordination channels, which hinders the transmission of knowledge and their possibilities to access the mining companies' technological demands. We therefore argue that policies should be oriented to strengthen the linkages between mining suppliers and external sources of knowledge, as well as the coordination channels among the firms in the sector.

Our results are relevant for several reasons. First, they provide evidence that technological upgrading can indeed occur in NRIs in developing countries, even when conditions for innovation and governmental support are weak.[1] This provides supportive evidence to the recent strand of literature that challenges the previously accepted view that economic sectors such as mining do not provide opportunities for local technological sophistication. Second, this paper explores a generally overlooked issue in literature on technological upgrading in developing countries, which is the distinction between incumbent firms and new ventures when analyzing how linkage dynamics influence innovation patterns. Third, evidence on the nature and scope of innovation activities by local mining suppliers in developing countries remains scarce. Therefore, we contribute by generating new qualitative information that helps understand the dynamics of this process and complement previous findings in other countries.

Moreover, our findings might be indicative of the beginning of a process of technological maturity among Peruvian mining suppliers. We have shown that, by seizing their local experience and contacts, some incumbent firms in the country have recently begun to shift towards more knowledge-intensive activities. Particularly, our research suggests that specific niches pose opportunities for local firms to take advantage of their local experience and provide innovative solutions to unattended needs in the sector, thus expanding their markets and gaining an international reputation. However, we also provide evidence on how institutional weaknesses may limit the possibilities for technological upgrading considerably. Considering the emerging opportunities for local linkages in the mining industry, we believe that policies should address this issue by improving the conditions for capability building in the sector and facilitating the flow of information regarding the mining companies' technological demands.

This paper proceeds as follows. In Section 2, we introduce the theoretical framework that will guide our analysis and briefly describe the current opportunities that the Peruvian mining sector offers for technological upgrading and diversification. Section 3 then describes the methodology applied in this study. In Section 4, we address the experiences of the suppliers interviewed in order to understand the factors that allowed them to integrate into more knowledge-intensives stages of the value chain. Specifically, we will first describe the governance patterns along the mining value chain and analyze how interactions between mining firms and suppliers affect innovation efforts by local contractors. Second, we will explore the nature of the learning trajectories of the suppliers in our sample, with emphasis on the factors that enhanced these firms' learning curves, as well as the role of the institutional setting in this process. Finally, Section 5 will summarize the main results of our research and derive some policy implications.

## 2. Background

### 2.1. NRIs and technological upgrading in developing countries

Economists have developed many different theories to assess the determinants of technological upgrading in developing countries. Although this concept has various interpretations, recent studies argue that it should be understood as the development of technological innovations that produce increases in value added (Morrison et al., 2008). Technological upgrading can be achieved through different strategies. These may be linked to the value of products (product upgrading) or the efficiency of production processes (process upgrading), as well as to more complex strategies oriented to developing new functions in the sector's value chain (functional upgrading) or applying competences acquired in a particular function to move into new chains (inter-chain upgrading).

A first approach to understanding innovation patterns in developing countries focuses on the importance of international inter-firm linkages in enhancing knowledge transmission and technological efforts. This literature builds on the idea that the nature of the relationships between actors in the global value chain may take different shapes, which in turn have important implications on production patterns and upgrading opportunities (Humphrey and Schmitz, 2000). The most common theory of governance patterns in global value chains was developed by Gereffi et al. (2005), and considers three key factors: (i) complexity of transactions, (ii) ability to codify transactions, and (iii) capabilities at the supply base. Different combinations of these variables result in a classification of value chains that range from low to high levels of explicit coordination and power asymmetry. The main types of chains identified by these authors are:

- Markets: Low asset specificity and information complexity. Little explicit coordination needed, which reduces switching costs.
- Modular value chains: Higher product complexity, but interactions remain simple due to codified information. Asset specificity and switching costs remain low.
- Relational value chains: Higher asset specificity, tacitness of information, and supplier capabilities lead to complex interactions. Development of mutual dependence and high switching costs.
- Captive value chains: due to low capabilities, suppliers become transactionally dependent on larger buyers. Complexity of information and asset specificity require monitoring by lead firms.
- Hierarchy: lack of suppliers with enough capabilities to handle product specifications and tacit knowledge creates the need for vertical integration between stages of the value chain.

[1] Peru only invested 0.12% of its GDP in R & D in 2015, well below the Latin American average (0.67%).