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Cluster perpetuation: Maintenance of competitive advantages over time. The case of Chile's large north☆

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ABSTRACT

Industrial clusters last if they can maintain over time the competitive advantages arisen from external economies and joint actions developed in the cluster itself. The trend towards relocation of activities outside the cluster, in other geographical areas, may be restrained by a number of inhibiting factors or barriers relating to the exit or abandonment of the cluster, such as the sense of belonging to the cluster, the density of the network of relationships established, the existence of shared norms and values, and the institutional framework of the cluster. Thus, the greater the presence of these factors is, the lower companies' trend to leave the cluster will be. This paper analyses the cluster perpetuation model, based on the calculation of the probability of activity relocation, applied to the Antofagasta (Chile) mining cluster, using a multiple binary logistic regression.

1. Introduction

In recent times the authorities of several mining regions have promoted growth strategies based on the promotion of mining clusters, in order to increase the capacity of the region to appropriate part of the income generated by the mining activity, through the generation of an industrial atmosphere that allows the local companies, generally suppliers of the multinationals, to increase their competitiveness and thus to generate wealth in the region, although the foreign multinationals remain as the main actors of these clusters (Altenburg, 2001). This is the case of the mining cluster of the region of Antofagasta (Chile).

According to the Instituto Nacional de Estadísticas de Chile (online) (National Statistics Institute), the population of the region of Antofagasta in 2017 is 640,950 inhabitants, which represents 3.5% of the Chilean population. Traditionally, the main economic activity of the region has been, and will remain being, the mining business. As noted by the Consejo Minero de Chile (online) (Mining Council of Chile), in 2015 the copper mining contributed 48% of the GDP, and around 95% of the exports in this region, generating 25% of regional employment. Besides, according to the Servicio Nacional de Geología y Minería (2014, online) (National Service of Geology and Mining), the region of Antofagasta leads the copper production at the national level, with 3,048,303 out of a total of 5,851,120 metric tons of fine copper produced in 2013; concentrating a 52% of the national production. The copper production in Chile in 2016 was 5.55 million tons, becoming the main world producer of this mineral, accounting for 28% of the world copper production, and having 29% of world reserves according to the Consejo Minero de Chile (online) (Mining Council of Chile). Therefore, it is not surprising that in the region of Antofagasta the large mining multinationals have been settled: Freeport-McMoran, Antofagasta Minerals, Marubeni Corp., BHP Billiton, Antofagasta PLC; Glencore, Barrick, Rio Tinto, KGHM International, Anglo American, Xstrata, Sumitomo Metal Mining, Codelco, among others (Consejo Minero de Chile, 2017). Although traditionally, since 1880, the presence of mining MNCs in the region responds to the enclave (settlement) concept, with a highly dependent economy on such multinational corporations (Arias et al., 2013); as exposed by Arroyo and Rivera (2004), the local community, in the last years of the 1990s, responded with the strategy of forming a productive cluster around the big mining sector, in order to seek a productive model that would leverage in the mining activity and offer stability to the local economy, although a fundamental challenge that conditions its viability, is the capacity of local actors to consolidate a true synergetic relationship that allows to achieve scale economies and create innovation in the various products and processes of the copper mining. The Region has the largest deposits of copper, iodine and lithium in the world, as well as major reserves of silver and molybdenum (US Geological Survey, 2016).

It was at the beginning of the 1990's, as noted by Arroyo and Rivera (2004), when the transformation of the mining in the region of Antofagasta was developed, based on the investment made by companies

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with foreign capital. Thus, little by little, a new way of interacting with the local community arose in the operations of the business; moving from the system of mining enclave to the configuration of a system of large foreign companies with outsourcing of functions towards small and medium-sized local companies. The objective was obvious: to increase the efficiency of production and reduce costs. As Arroyo stated (2003), the pressure to operate at the lowest costs possible means that, as a general rule, large-scale mining operates with state-of-the-art technology. However, the way in which mining MNCs are linked to the community of the region allows them to obtain certain comparative advantages which are inherent to the territory, therefore it is necessary to develop social capital and local capacities. This flexible production system looked for a closer bond with the local community through the generalised outsourcing of services, which later pushed the attempts to constitute a mining cluster in Antofagasta. The challenge facing the mining cluster in Antofagasta is to create a system of operations based on the mining knowledge acquired over the years, and which will also allow the transfer of knowledge, technology and innovations to local companies. In order to achieve that, the development of capacities linked to the creation of human and social capital should be strengthened, since in clusters based on natural resources, such as miners, their competitive advantages are a reflect of those owned by the region (Altenburg, 2001). In this context, the mining cluster of Antofagasta aims to link the mining MNCs with the industrial activities and local services. The idea is that the region of Antofagasta continues exporting not only copper, but also machinery and services for world mining, i.e. products with higher added value, whilst reducing its economic dependence of a non-renewable natural resource. As stated by Lufin (2002), at the level of the region of Antofagasta, the way to achieve competitiveness and economic development inevitably went through the alliance between the large multinational mining companies, the regional government, regional small and medium enterprises of manufactures, services, universities and technological centers, to drive the creation of a cluster. The purpose was, and still is, the creation of a network that allows learning and innovation processes in the industrial operations of copper ore processing and, in addition, develop activities that provide supplies, engineering services and equipment. However, since it is a cluster dominated by large foreign MNCs, the participation of local companies is limited to the role of suppliers of manufactures and various services. Thus, although the MNCs have a high technological level and there are interactions between different links in the value chain, the degree of linkage with the local entrepreneurship and the potential for learning and innovation processes at the cluster level are low. On the other side, as stated by Altenburg (2001), these clusters carry out standardized operations which are based on codified knowledge, and therefore do not require a regional environment that supports innovative activities. The detonator of development in these clusters is often foreign direct investment, which then induces others to invest in the same segment or in activities linked back or forth.

The strategy to promote a mining cluster in the region of Antofagasta pretends to take advantage of external economies the territory provides, benefiting from proximity to others, the existence of infrastructure and equipment, diversified consumer and labor markets and better access to information and knowledge (Sölvell, 2009). In addition, they may also benefit from a more valued social, cultural and institutional environment (Becattini et al., 2009) and from joint actions deliberately carried out in cooperation with other companies in the location (Schmitz and Nadvi, 1999). In this way, they benefit from established *untraded interdependences* (Storper, 1992), a number of competitive advantages generated in the location and which companies are able to internalize to their advantage; this promotes companies' interest to be located in the cluster and, for those already belonging to it, to remain within it. Companies' interest to remain in the cluster or be located in it depends on the capacity of clustered companies to maintain over time, and even increase, the set of competitive advantages arisen from the territory, which they may internalize. One of the morphological characteristics of clusters is their ongoing transformation and change, associated with the processes of creation and diffusion of innovation and knowledge, and their adjustment to the changing environment and market recomposing (Vázquez-Barquero, 2006). The mining clusters of Antofagasta have a huge presence of large multinational corporations that dominate the local economy. These enterprises aim to export and are nourished by a set of local suppliers that are organized as the radios, with a high level of subcontracting (Arias et al., 2013). However, such clusters can also become longevity and competitive by taking advantage of agglomeration economies. In order to achieve this purpose, an efficient and innovative local suppliers system should be consolidated to whom the MNC's may transfer knowledge and technologies to local companies (Gray et al., 1996).

The purpose of this article is to apply a perpetuation model to the mining cluster in Antofagasta, based on the model proposed by Molina-Morales and Ares (2007). In a globalized world, the change in location of activities towards other countries, or relocation, has become widespread in recent decades. However, as these authors indicate, the existence of an environment with large interdependencies between companies and institutions in the same geographic area, as it happens in industrial districts and clusters, suggests the emergence of resistances or factors inhibiting this phenomenon (Molina-Morales and Ares, 2007). Thus, the model tries to verify that the companies belonging to a cluster have a low probability of relocating their activities in other places. Therefore, Molina-Morales and Ares (2007) propose, based on the concept of social capital, a binary logistic regression model with four explanatory variables, which respond to the four inhibiting factors of the relocation they identify, and which are: the sense of belonging to the cluster, the density of the network of relationships established, the existence of shared norms and values, and the institutional framework of the cluster. The perpetuation model of the clusters has been applied by Molina-Morales and Ares (2007) themselves in the analysis of the industrial district of ceramic in Castellón (Spain), research of which they conclude that the factors related to the social capital developed in such industrial district act like true inhibitors or self-restraint of the decisions to locate activities outside the district; specially the feeling of belonging, the density of network relationships, and shared norms and values. Regarding institutional relations, although they point in the same direction, they do not find significant evidence that this variable affects the decisions of remaining in the district.

The application of this model to the mining cluster of Antofagasta, with a high presence of multinationals on which the local suppliers depend, where the supply of the suppliers to the mining MNCs is usually under a long-term exclusivity contract, being a hub-and-spoke type, together with the fact that the extraction of minerals can only occur in the locations where there are reserves of that mineral, suggests that the relocation possibilities of the companies that supply the mining cluster of Antofagasta are scarce. In this matter, the empirical research that we carried out on the local suppliers of the mining cluster of Antofagasta allows us to analyze two questions: (a) if any of the four inhibitory factors that identify these authors actually decrease the relocation probability in other places of the local supplier companies, and (b) since each of these four factors can be associated with a type of proximity of those identified by Boschma (2005), if any of these proximity concepts generates advantages to the local supplier companies by being part of a production network, with the consequent learning and exchange of knowledge. The results of the empirical study performed attest it this way, because only the influence of two inhibiting factors of the relocation is accepted: the sense of belonging to the cluster and the density of the network of relationships established, but based on simple backward chains of supply of inputs and services, that means, only the existence of cognitive and organizational proximity is verified, but the existence of social and institutional proximity is rejected.

This article is divided into five parts. In addition to this introduction, Section 2 presents the theoretical aspects related to the perpetuation model of Molina-Morales and Ares (2007) and its relation with