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Determinants of country competitiveness in attracting mining investments: An empirical analysis

J. Joaquín Jara

Departamento de Ingeniería de Minería, Pontificia Universidad Católica de Chile Av. Vicuña Mackenna 4860, Santiago, Chile

A B S T R A C T

This study contributes to the debate on the competitiveness of countries to attract mining investments. The specific objectives of this work are: to bring empirical support to the alternative view of mining competitiveness, which highlights the key role of country's investment climate; and to propose a methodology, based on cross-country econometric models and the economic theory, to understand how the geological potential and the investment climate interact to define country's mining competitiveness.

The research show that long-term mining competitiveness is not solely determined by the geological potential of countries. The models corroborate that both, geological potential and investment climate, are crucial to explain country's attractiveness. Moreover, the results suggest that the relationship of these two variables is not developed individually and additive, but through an interaction of both terms.

Finally, the study identifies an "investment climate threshold area" in its final model. Mining competitiveness of countries with low investment climate depend on the interaction between their geological potential and investment climate. On the other hand, countries above this threshold compete for mining funds almost exclusively based on the mineral endowment of their territories. These findings could have relevant consequences in country's strategic decisions for the mining industry.

1. Introduction

From late 60's to late 70's the mining industry experienced an increased participation of state enterprises in its markets. However, from mid-80's and after the failure of several states to exploit their natural resources, many countries opted for the privatization of state-owned mining companies and open their territories to private capital. Therefore, at present private companies seek and develop mining projects throughout the world, including significant participation of large multinational corporations dominating the industry. As a result, now countries who want to develop its mining industries must compete for expertise and capital to attract international investments.

The traditional view of competitiveness in mining, based on the Theory of Comparative Advantage and International Trade, states that competition between countries to attract mining investments is largely based on the natural endowments of their territories. This theory emphasizes the importance of quality and quantity of mineral resources, and gives less relevance to other factors that can also affect country's attractiveness (such as skilled workforce, appropriate infrastructure, social stability, etc.). Therefore, countries with more resources of better quality are going to receive more investments, and only after the depletion of these resources companies will go to invest in other less attractive destinations (Tilton, 2002). Consequently, under this interpretation countries can do little or nothing to encourage the development of local mining industries and rely only on nature blessings.

In contrast, an alternative view arose in the mid-80's from various negative experiences. In the previous decades several mineral rich countries were unable to exploit their resources and increase their participation in the production of minerals and metals. The alternative view explained these events by the presence of two main determinants of country's mining competitiveness: the geological potential and the investment climate (Johnson, 1990; Tilton, 1992, Fraser Institute, several years). According to this interpretation, although mineral resources are essential to develop a local mining industry, it is also necessary to offer to the investors the right conditions to explore and exploit those resources in an efficient way. These conditions define the investment climate, a concept summarizing many variables that companies must take into consideration when they try to develop and exploit a mineral deposit. Within these variables, usually it could be mentioned: an adequate infrastructure, the availability of human and intellectual capital, a social and political stability, the existence of

E-mail address: jjjara@uc.cl.

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clear and reliable institutions and regulations, an adequate tax regime, and specific regulations for the mining sector, among others.[1]

This alternative view of competitiveness has more than 20 years since its formal statement, and is a broad consensus in the mining industry. However, few attempts to support it through empirical evidence have been done. Khindanova's works (2005, 2006 and 2007, which are different versions of the same study) are the only known efforts to use real data to find a causal link between mining investments (exploration budgets in these particular cases) and indicators of geological potential and the climate for mineral investment. Those working documents were finally published in two journals, summarizing her findings (Khindanova, 2011, 2015).

While Khindanova studies are a significant step to track this relationship between mining competitiveness and its determinants, there are still large areas to contribute on the discussion and validation of the alternative view.

The purpose of this research is to contribute, with empirical evidence, to support the alternative view of mining competitiveness. A complimentary objective of the research is to propose an approach, based on economic theory, to understand the contribution of the geological potential and the investment climate in the country's mining competitiveness. The methodology proposed to achieve these goals is based on cross-country econometric models to test the relationship between an indicator of mining competitiveness and particular measures of geological potential and investment climate.

Therefore, the study is structured as follows. Section 2 reviews the main aspects of Khindanova's works, their contributions and limitations. Then Section 3 describes the variables and datasets used in this research. The general methodology and the econometric models are presented in Section 4. Section 5 shows the results of the work. Finally, Section 6 close the paper with a brief discussion of the results and some possible extensions of the research for future studies.

2. Background review

As stated in the introduction, Khindanova's works (2005, 2006 and 2007) are the only known efforts dedicated to empirically connect some measures of the geological potential and the investment climate to mining investments in a particular country.

The objective of these studies is to identify the relevance of the geological potential and investment environment in the location of exploration budgets. To do this, Khindanova uses three types of econometric models: general semilog models, general log-linear models and truncated log-linear models.[2] In all of her models, the dependent variable is the logarithm of exploration budgets[3] by country and the independent variables are the geological potential and the investment climate. Thus, the general formulation of the models is:

$$LExpl_i = f(IPG_i,\ ICI_i) + \varepsilon_i = \propto + \beta_1 * IPG_i + \beta_2 * ICI_i + \varepsilon_i \quad (1)$$

where $LExpl_i$ is the logarithm of total exploration budgets, IPG_i is an index of geological potential and ICl_i is an index of investment climate, all for the ith country.

Due to the absence of reliable and widely available indicators for geological potential and mining investment climate, she proposes alternative variables that could be used as proxies of the "real" independent variables. Initially, she uses various measures associated with the participation of the mining sector in the economy of the countries as possible proxies for geological potential (share of primary exports on total exports, share of mining exports on total exports, share of mining GDP on total GDP, etc.). After these efforts, she try with measures for the relative abundances of minerals (estimated resources and mineral reserves, mining production, number and length of mining concessions, territorial extension, etc.; Khindanova, 2005, 2006). Regarding mining investment climate, she uses only two proxies: the Governance Index from the World Bank; and the Index of Economic Freedom published by the Heritage Foundation and the Wall Street Journal.

The results show that, among the variables used in her research, the best indicator of the geological potential of a country is its land area. The other interesting result is that there are no significant differences to use the Governance Index or the Index of Economic Freedom as a proxy for the investment climate (Khindanova, 2005, 2007). Her works also note that both variables, geological potential and investment climate, are relevant to define the location of exploration budgets. They represent around 50% of the decision to invest in one country rather than in another one (Khindanova, 2011). These results are in line with the alternative view of mining competitiveness, providing a first empirical support to it.

The largest two contributions of Khindanova's early works (Khindanova, 2005, 2006) are: the formulation of an empirical model to show the relationship between a country's market share (in this case, total exploration budget) and the variables associated with the alternative theory of mining competitiveness; and to explore alternative variables to measure country's geological potential and mining investment climate.

On the other hand, in her third paper Khindanova (2007, 2011) extends her previous works by adding other variables to the econometric model. To see the effect of the size of local economies in the location of exploration budget, the author introduces countries GDP and population as additional explanatory variables. In addition, she includes an interaction term between the geological potential and the investment climate to capture possible effects of the investment climate in the geological potential and vice versa.

The results of this second set of models show that both GDP and population are not relevant to explain the location of exploration budget. However, the interaction term between the geological potential and the investment climate is statistically significant, raising questions regarding the original models specification.

Therefore, the main contribution of this third work from Khindanova (2007) is to show that the relationship between the explanatory variables and the dependent variable is not necessarily the additive interaction proposed in her earlier studies (Eq. (1)).

Nevertheless, one of the main shortcomings in all Khindanova's works lie precisely on the foundations of model specifications and the poor use of the results obtained in the research. The inflexible specifications of her models are not based on an economic hypothesis about the process governing the decisions carried out by the exploration companies.

For example, with an additive model specification a country with excellent investment climate, but with little or no mineral endowment, will still be able to attract substantial funds for exploration. A situation that is unlikely to happen in the real world. Similarly, a country with great geological potential but with highly political and social instability (very low investment climate), it will also may get a significant share of global exploration spending. A situation that also appears as unreal.

This study attempts to overcome these problems by relating previous studies on mining competitiveness (Tilton, 1983, 1992; Johnson, 1990; Fraser Institute, several years; etc.) with two recent papers: the study of Jara et al. (2008) on indicators of mining competitiveness; and Khindanova's works on the location of exploration investments. This approach allows to improve previous works through: a solid economic foundation for the empirical analysis; a robust process to find the specification of the proposed models; and a better interpretation of the estimation results.

[1] For a complete review about the traditional and the alternative views on mining competitiveness, see Tilton (1992).

[2] Her results show no significant differences between general log-linear models and truncated log-linear models.

[3] In its annual report "Corporate Exploration Strategies", SNL (previously Metals Economics Group) informs exploration budgets for the next period.