Appendix to the article: Country Competitiveness and Investment Allocation in the Mining Industry: A survey of the literature and new empirical

Appendix about the proxy of geological potential[1]

As explaind in the article about the results obtained by Jara (2017) and Estrella et al. (2015), the main difference between these two equations is the negative sign of the variable that measures the geological potential obtained by Jara's (2017). To show the differences of these articles' results, this Appendix first presents **Figures 1 and 2**, which illustrate both equations in a plane, where the vertical axis measures the country's share in the total exploration investment budget (*Pexpl*). In contrast, the horizontal axis measures the geological potential of the country (%GVMP). In both graphs, we draw the relationship between *Pexpl* and GVMP (%) for different investment climate levels.

In **Figure 1**, the relationship between (budgeted) exploration investment and geological potential has an inverted U-shaped form. Starting from a positive value, the share of the (budgeted) exploration investment of the country on the total exploration budget increases as the geological potential goes up, attains a maximum level, and then starts to decrease as the geological potential continues increasing. The point at which the dependent variable, Pexpl, reaches its maximum value depends on the country's investment climate. For instance, a country with a remarkably high investment climate, with an index of 0.9 would be able to obtain 13% of the total budgeted exploration investment if it also had high geological potential.[2]

From a theoretical point of view, the results shown in **Figure 1** are intuitively correct, but only in the zone in which the curve has a positive slope. Exploration investment increases with the country's geological potential. The amount of investment that the country can attract will be higher if it has a better investment climate. Counterintuitively, after attaining a maximum level, the relationship between exploration investment and geological potential becomes negative. We obtain this result by using the assumption of Estrella et al. (2015) who considered a functional form somewhat arbitrary: the one that arises after applying a second-order Taylor expansion to Equation (2.1) in the paper.[3]

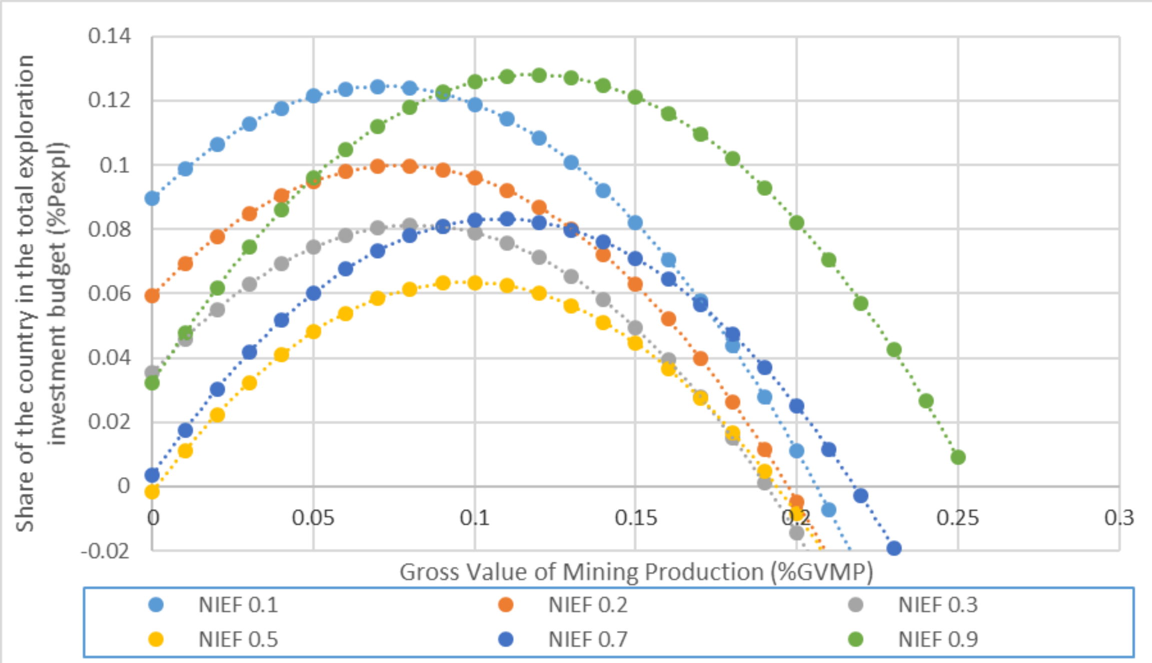
While it could be argued that in **Figure 1** there are very few countries placed on the zone with a negative slope of these curves, it does not allow us to conclude that the functional form of the Equation that Estrella et al. (2015) use is the correct one.

[1] This Appendix is a complement of the article "Country Competitiveness and Investment Allocation in the Mining Industry: A survey of the literature and new empirical evidence".

[2] For instance, a value of 0.12 represents the country's share in the total value of non-ferrous mine production.

[3] There are only two countries, China, and Chile, placed on the zone with a negative slope of the curves. However, these two countries are the two most important producers in the non-ferrous mining industry.

Figure 1: Budgeted exploration investment (Pexpl) vs. geological potential as the Gross Value of Mining Production (%GVMP)



Source: Estrella et al. (2015). Own elaboration.

Figure 2 shows the similar results obtained by Jara (2017). In that figure, we observe that the relationship between exploration investment and geological potential is negative for countries with an investment climate index below 0.5. In the database, there are nine countries with an investment climate index (*NIEF*) below 0.5. Hence, the use of the land area as a proxy to measure the geological potential of the countries does not allow obtaining consistent results.

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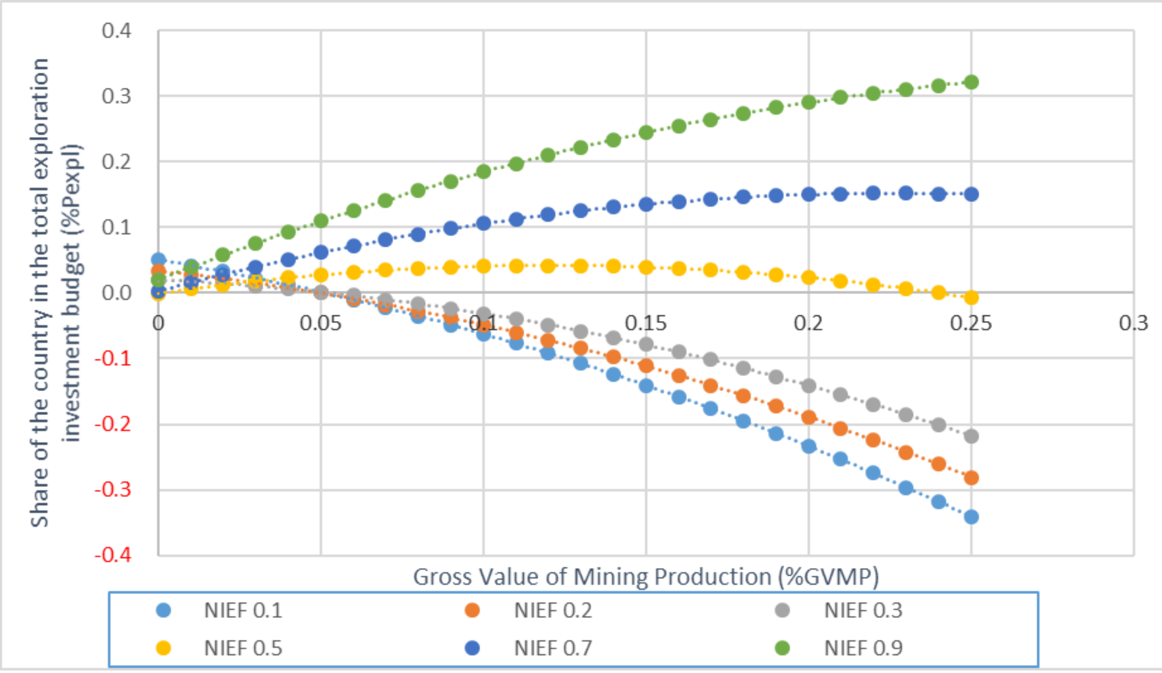
Figure 2: Budgeted exploration investment (Pexpl) versus geological potential as the land area (PLand)

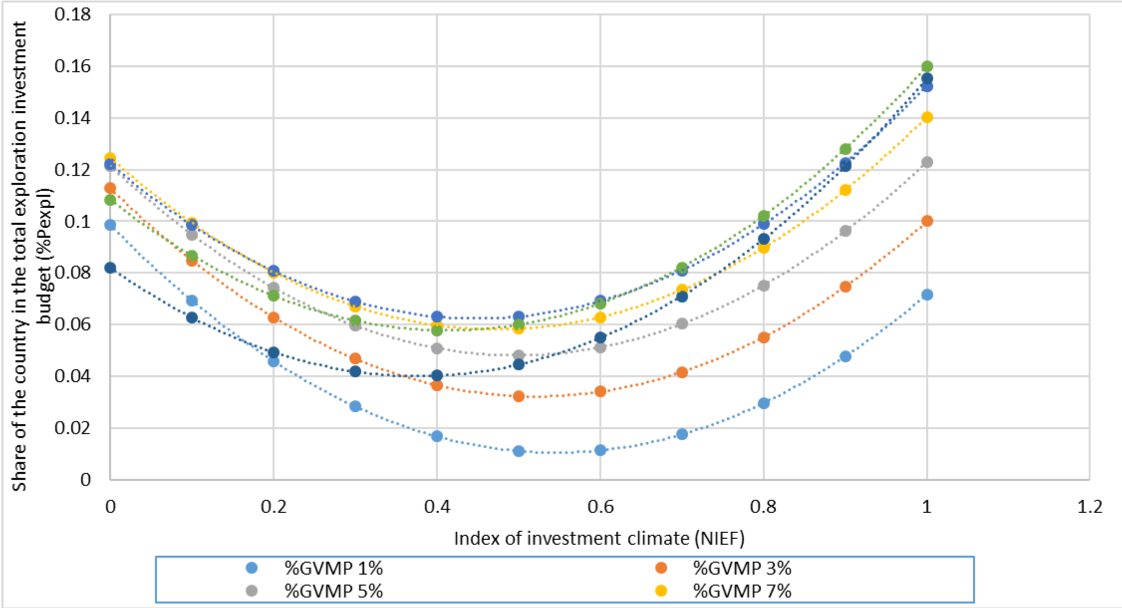


Source: Jara (2017). Own elaboration.

To complete the analysis, in **Figure 3** and **Figure 4**, both equations are drawn in a plane in which the vertical axis measures the share of the country in the total exploration investment budget (*Pexpl*). In contrast, the horizontal axis measures the investment climate (*NIEF*) of the country. Both figures depict the relationship between *Pexpl* and *NIEF* for different levels of geological potential. **Figure 3** shows the relationship between (budgeted) exploration investment and the investment climate has a U-shaped form. Starting from a positive value, the share of the (budgeted) exploration investment of a country on the total exploration budget diminishes as the investment climate increases, attains a minimum level, and then starts to rise as the investment climate continues increasing. The point at which the dependent variable, *Pexpl*, achieves its minimum value depends on a countries' geological potential. Obviously, in this case, the zone of the curve with a negative slope does not provide intuitively correct results. In the figure, we can see that the curves attain their minimum values within a range that goes from 0.4 and 0.5 of the investment climate index (*NIEF*).

From a theoretical point of view, the results shown in **Figure 3** are intuitively correct only in the zone in which the curve has a positive slope: exploration investment increases with the investment climate of the country, and the amount of investment that a state can attract will be higher if its geological potential is higher with respect to other countries. As was mentioned for the case of **Figure 1**, the fact that the curve has a U-shaped form is the result of the assumption of a functional form somewhat arbitrary, which arises after applying a second-order Taylor expansion of Equation (2.1). In this case, again, it could be argued that few countries are placed in the zone with a negative slope of each curve in **Figure 3**, but that does not mean that the functional form proposed by Estrella et al. (2015) is the correct one.

Figure 3: Budgeted exploration investment (Pexpl) vs. investment climate (NIEF)



Source: Estrella et al. (2015). Own elaboration.

Figure 4 shows similar results obtained by Jara (2017). In this case, the negative sign of the parameter β_1 makes negative the value of the dependent variable (*Pexpl*) for countries with a very high geological potential but with low "levels" of investment climate, an outcome that seems to be inconsistent. Thus, comparing the results shown in **Figures 3 and 4**, one can conclude that using the country's land area as a proxy for geological potential, instead of %GVMP explains the negative relationship between exploration investment and geological potential obtained by Jara (2017).

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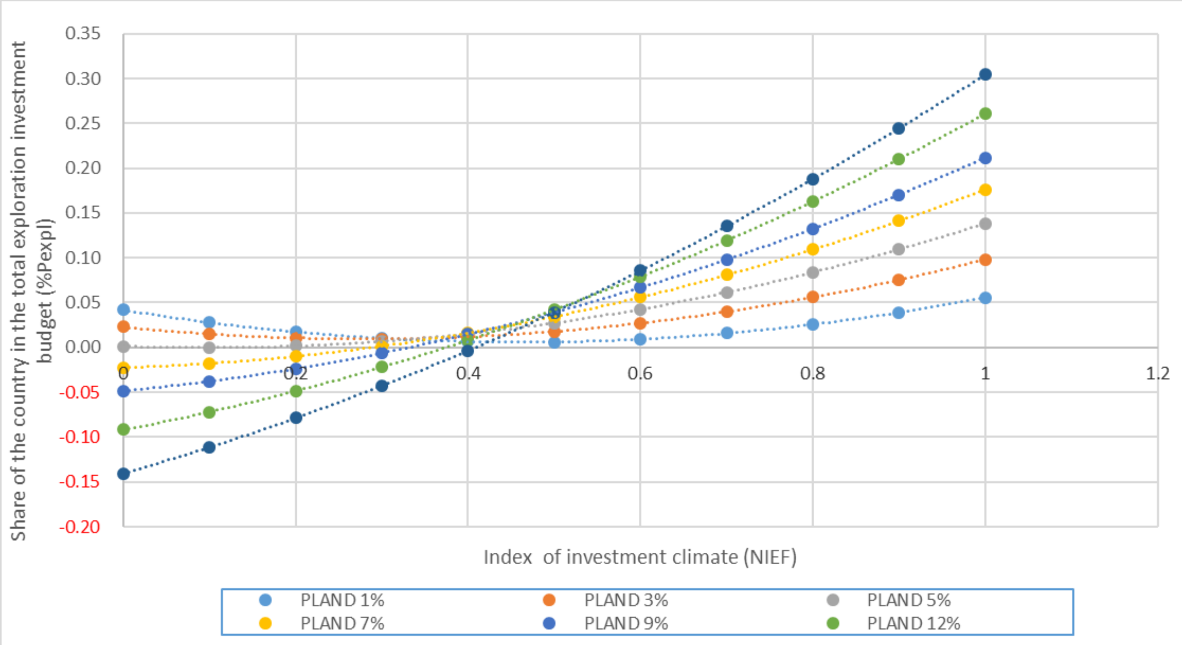
Figure 4: Budgeted exploration investment (Pexpl) vs. investment climate (NIEF)



Source: Jara (2017). Own elaboration.

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