A Real Options Model to Value Multiple Mining Investment Options in a Single Instant of Time

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Abstract

This paper studies two sets of exercising rules in valuing multiple real options, which are common in mining projects. The first set of rules compares and chooses the largest NPV for each path of uncertainty simulated, and the second set uses a polynomial regression based method. The two sets of exercising rules are applied to a promising copper mine with an option to expand and an option to abandon. The value of real options is larger (57%) with the first exercising rule than with the second one (8%). Also we found real options are more important in less promising projects.

Keywords: Exercising Conditions, Expansion Option, Abandon Option

1. Introduction

When it comes to mining, there are a number of factors that constantly vary in an unpredictable manner and which represent a risk for mines business. Looking at the big picture, we can consider endogenous risks where companies can deal with them in a more direct manner, highlighting poor management, accidents, irresponsibility of the workers, among others [3]. On the other hand, we have the exogenous risks, where companies cannot deal with them in a direct manner. In this case, governmental stability, taxes and market variations are highlighted.

Market fluctuation implicates price variations, and in the last 6 years, these oscillations of the prices have been specially manifested. For example, from 2005 onwards, copper prices have been very volatile, presenting a standard deviation of 0.8 which is almost 2.3 times the volatility presented in the period 1995-2005. Similar case can be found with other commodities like zinc, lead among others. This fact produces changes in project planning and in many occasions can produce the cancellation of entire operations.

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To model uncertainty of commodities, several models have been developed. Denoting P_t the price of a commodity at time t, and assuming that prices revert to some long-term equilibrium price determined by supply and demand (mean reverting processes), it is possible to define a simple model represented by the following stochastic differential equation [4]:

$$dP_t = \kappa(\mu - P_t)dt + \sigma dW_t \tag{1}$$

with $\kappa > 0$, $\sigma > 0$, $\mu > 0$ and dW_t a standard brownian motion.
By the way, many advanced models have been developed with the aim to represent the behavior of a commodity price in a good manner. Schwartz(1997)[5] proposes a single factor model similar to equation considering that the return of the commodity follows the equation (1).

$$dP_t = \kappa(\mu - lnP_t)P_t dt + \sigma P_t dW_t \tag{2}$$

On the other hand, Schwartz(1997)[5] propose a two-factor model, in which the first factor is the spot price of the commodity and the second one is the instantaneous convenience yield, δ. The factors are assumed to follow the joint stochastic process.

$$\begin{cases} dP_t = (\mu - \delta)dt + \sigma_1 dW_t^1 \\ d\delta = \kappa(\alpha - \delta) + \sigma_2 dW_t^2 \\ dW_t^1 dW_t^2 = \rho dt \end{cases} \tag{3}$$

Finally, Schwartz & Smith (2001)[6] propose a two-factor model that considers the price explained for both, short- and long-term variation. Through this model, it's possible to model the equilibrium price, that in most of the cases is uncertain. Thus, the spot price is decomposed into two stochastic factors as $lnP_t = \chi_t + \xi_t$ where χ_t is referred to as the short-term deviation price and ξ_t the equilibrium price level. For both factors the equations are:

$$\begin{cases} d\chi_t = -\kappa\chi_t dt + \sigma_\chi dW_t^\chi \\ d\xi_t = \mu_\xi dt + \sigma_\xi dW_t^\xi \\ dW_t^\chi dW_t^\xi = \rho dt \end{cases} \tag{4}$$

To deal with uncertainty in projects, most of the time, mining companies evaluate their projects by using standard DCF analysis which has not changed much since Fisher(1907) first proposed it. This methodology computes the Net Present Value (NPV) by discounting the expected cash flow at a certain discount rate. Moreover, in this context, it is possible to model uncertainty by capturing with mathematical tools a low (pessimist), average or high (optimist) scenario of a project, but ignores the flexibility of an investment decision.

All this motivates strongly a more complete valuation methodology that allows including both uncertainties and flexibilities, hence improving the valuation of projects. In this sense, Real Option Analysis (ROA) captures in a single value called Extended NPV, the standard NPV plus the flexibility in the investment decision [1].

We can find many kind of real options in mining such as option to abandon, to modify production capacity, to defer, sequencial options among others [7]. This paper focuses on options that can be exercised in a single instant of time . In an analogy with financial options it can be seen as a european option. Moreover, the models presented here are meant to deal with multiple exclusive options such as the option to increase or decrease production capacity, to close the mine, among others options fixed in a single instant of time in the future t_e.

2. Model

The model aims to capture the option value associated to mining flexibilities. The flexibility considered is limited to multiple investment alternatives in a single instant of time. To give a context, we consider an arbitrary mine that produces just one commodity whose price is uncertain in the future. Besides, we consider two kinds of options: Option to Expand and Option to close mine [3]. Let t_e (in years) be the time at which option can be exercised. Thus, we consider the existence of three mine plans:

- Mine plan without expansion in production capacity(OWO). This is the current mine plan considered by the mine.
- Mine plan with the expansion in production capacity(OW).
- Mine plan to close mine(Close).

In this model, I consider that the mine plans contain all relevant information for the life of the asset, such as production levels, expected ore grades, recoveries, and operating costs, amongs others. The only uncertain information is the commodity price which is, clearly, a simplification. Moreover, we consider a cost

[3]The options are just an example of other option that can be taken into account. This model can be extended to more options in a single instant of time such as options to expand with different production capacities, option to exploit new resources among others.

associated to close the mine in M$ US C.

Let T_{OWO} be the life of the asset (LoA) in years of OWO, and T_{OW} be the LoA of OW. All these times have as reference the initial time (time 0), that is the valuation day. As OW considers an increase in production capacity and not other reserves are taken account, the life of the asset is reduced. Thus, it holds $T_{OWO} > T_{OW}$.

To model the stochastic behavior of the price of the commodity, P_t , we consider a classical mean reversion model exposed by equation (1). It is possible using other models but, in this case, we are more interested in dealing with flexibilities than with model uncertainty.

Let $\{\omega_k\}_{k=1}^{K}$ the sequence of price paths simulated which are obtained by simulating process in equation (1). Paths are simulated until time T_{OWO} since this time is the highest one to be considered in the project. Let $\mathbf{P}$ be a matrix containing all paths $\{\omega_k\}$ in their rows and $\mathbf{e}$ be a vector which will have the optimal strategy (expand, close or keep at time t_e once the exercising condition (decision rule) is defined. Each component of vector $\mathbf{e}$ can take either 1,0 or -1 according with the option to expand, keep current mine plan or close mine respectively. Figure 1 summarizes what was explained before.

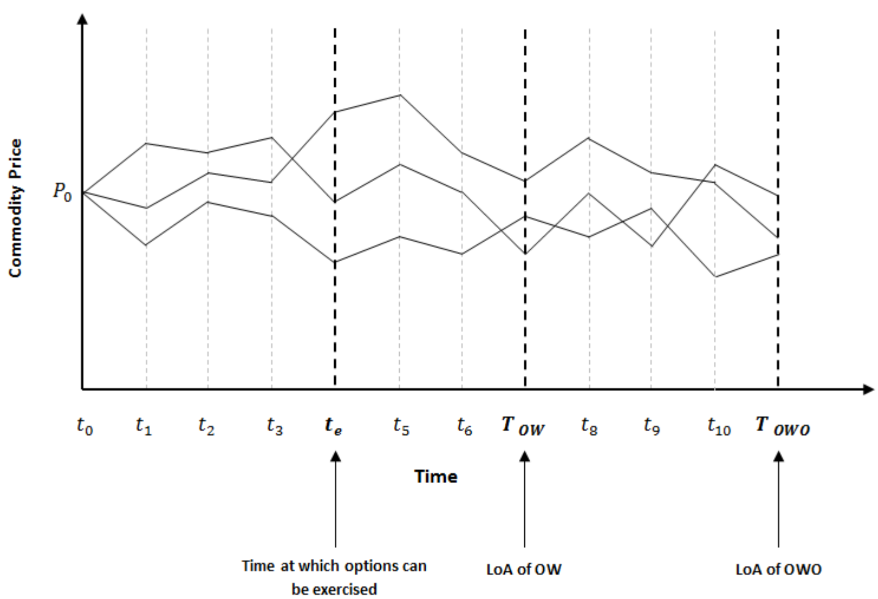

Figure 1: The figure shows the three relevant instants considered in the model together with some paths of simulated prices.

With this information we need to fix an exercising condition which allows us to compute the Extended NPV. This section gathers the important points of this model.

Viewing simulated prices at year t_e, we construct two alternatives for determining an exercising condition which conclude in two different models. I will consider both and then I will make a comparison between them.

The first way to determine exercising condition, and maybe the most simple, is to consider for each path ω_k the value of the remainder NPV (NPV computed from year t_e and considering just future cash flows from this time) of both alternatives: $NPV_{OW}^{rem}(k)$ (NPV of OW) and $NPV_{OWO}^{rem}(k)$ (NPV of OWO). Thus, we can complete the vector $\mathbf{e}$ as follows

$$\mathbf{e}(k) = \begin{cases} 1 & NPV_{OW}^{rem} > NPV_{OWO}^{rem} \& NPV_{OW}^{rem} > C \\ 0 & NPV_{OWO}^{rem} > NPV_{OW}^{rem} \& NPV_{OWO}^{rem} > C \\ -1 & other\ case \end{cases} \tag{5}$$

We call this condition as the *Exercising Condition* 1. Next we can compute the extended NPV as the mean of all NPVs following each price path simulated with the optimal strategy contained in $\mathbf{e}$.

On the other hand, we propose other exercising condition that we call *Exercising Condition* 2 by comparing expected NPVs given a determined price at the decision time. To do so, we estimate both $NPV\,OW$ and $NPV\,OWO$ by using a polynomial regression respect to simulated prices at the moment of taking the decision. We consider for both estimations polynomials of degree M. Next equations show this point

$$\begin{cases} NPV_{OWO}^{rem}(k) = \sum_{i=0}^{M} \alpha_i P_{t_e}^i + \epsilon_k \\ NPV_{OW}^{rem}(k) = \sum_{i=0}^{M} \beta_i P_{t_e}^i + \eta_k \end{cases} \tag{6}$$

By estimating constants α_i and β_i, it is possible to obtain the estimator of remainder NPV in terms of the price at the instant of taking the decision as follows

$$\begin{cases} \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) = \sum_{i=0}^{M} \hat{\alpha}_i P_{t_e}^i \\ \mathbb{E}(NPV_{OW}^{rem}|P_{t_e}) = \sum_{i=0}^{M} \hat{\beta}_i P_{t_e}^i \end{cases} \tag{7}$$

Estimations obtained aim to the estimated NPV as is shown in Figure 2.

The remainder NPV of the option to close the mine is not estimated since this alternative worth always C; the cost of closing mine.This way, we include in the decision for each path, all possible information about the prices that will determine the future remaining NPVs, for three investment options. Thus, the exercising

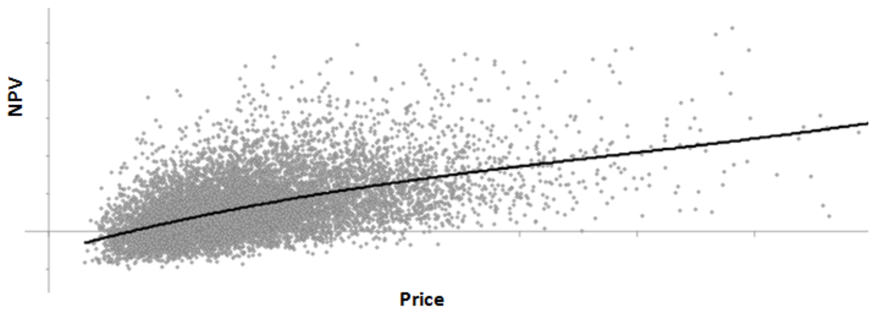

Figure 2: The figure shows the set of pairs (price, NPV) and a polynomial adapted to those points by the mean of least squares.

condition is:

$$\mathbf{e}(k) = \begin{cases} 1 & \mathbb{E}(NPV_{OW}^{rem}|P_{t_e}) > \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) \\ 0 & \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) > \mathbb{E}(NPV_{OW}^{rem}|P_{t_e}) \& \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) > C \\ -1 & othercase \end{cases} \tag{8}$$

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An advantage of this exercising condition is that it allows fixing a clearer decision rule. As we have three polynomial expressions (two polynomial of degree M associated to OW and OWO and one polynomial of degree 0 associated to the option to close) as estimators, our rule of making or not the expansion can be transferred to a visible price. This is possible by solving next equation system

$$\begin{cases} \mathbb{E}(NPV_{OW}^{rem}|P_{t_e}) = \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) \\ \mathbb{E}(NPV_{OWO}^{rem}|P_{t_e}) = C \end{cases} \tag{9}$$

We refer to these prices as *exercise prices*. In particular, we call *exercise price to expand* to the minimum price at which expansion is made and *exercise price to close* to the maximum price at which mine must close the mine operation. This point is shown in Figure 3.

These exercise prices give us useful information for the construction of a decision rule which is desired by the investor since it gives visible information to take better and more informed decisions. Once vector is determined, it is possible to compute the estimated NPV with its flexibility computing for each path the NPV according with the decision rule constructed.

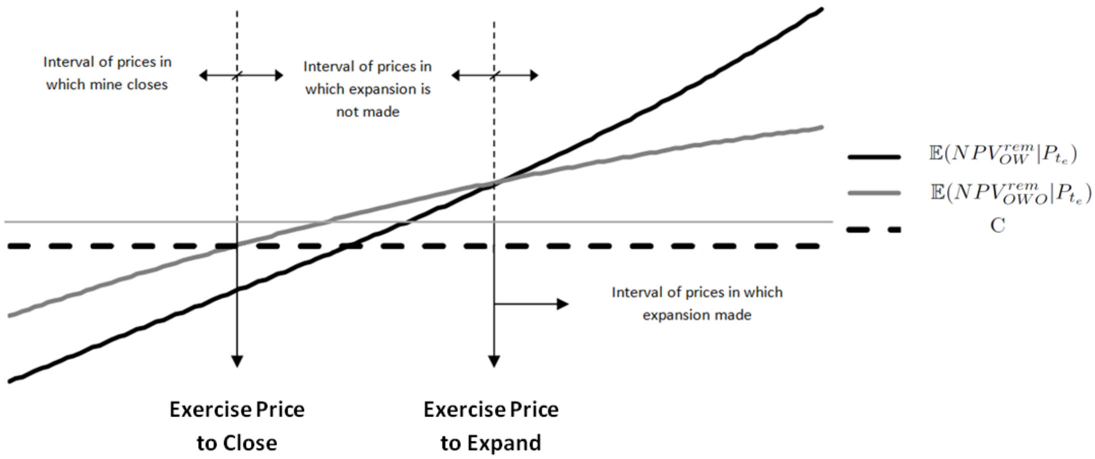

Figure 3: Exercise prices as the intersection of estimated remaining NPV

On the other hand, we are not doing a direct analogy with financial options which assumes as current strock price the present value of expected cash flows and as exercise price the investment cost for applying black scholes formula[2]. Instead, we are dealing directly with commodity prices (instead present value of expected cash flows) and with exercise price (instead investment cost).

An issue to remark at here is that sometimes the exercising condition 2 makes mistakes. The exercise prices come from estimation about how prices explain remainder NPVs, however these exercise prices deal with an average behavior of NPVs and cannot deal completely with price uncertainty. In Figure 4, an example of this point is exposed considering just one exercise price. As it can be seen, if we have a price on the exercising region (marked in gray) we exercise the option expecting that the alternative exercised is the best which, in fact, happend with the path price i. However, it can happen that prices evolves towards low levels (price path j) and then future cash flows does not allow recovery the capex invested which concludes in an unsuitable investment.

3. Application

An example is implemented directly following the proposed model considering a copper mine. To do so, three mine plans are considered (see annex for further details). The first contains information about the current mine plan which does not consider any expansion (OWO). The second one is the plan with relevant information about the expansion (OW) while the third is the mine plan to close the mine (Close). For all

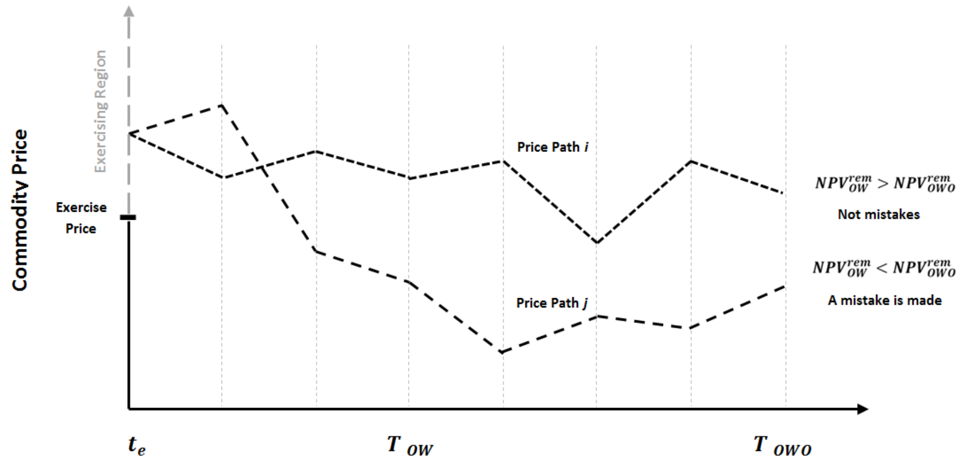

Figure 4: The figure shows how the exercise price criteria can result sometimes in a decision mistake

purposes in this example, parameters used to capture the option value are shown in Table 1. The parameters associated to copper price were estimated from historical data. More details can be found in [4].

Parameter	**Value**
Number of Paths	100000
Polynomial Degree	3
P_0 (year 2011)	4.088 US$ /lb
κ	0.21
μ	2.15
σ	0.5598

Table 1: Parameters used in the model

Following the classic valuation method of DCF, it captures the value of the better investment alternative and chose it. In this example, this alternative is OW and it is shown in Figure 5.

Fixing the attention in the expansion we see that their value corresponds to the incremental value between OW and OWO. Thus, the expansion worth M $ US 112.98.In this way, we can also construct the excepted cash flows in function of the expected copper price as is shown in Figure 6 and Figure 7 for the case of OW and OWO.

Thus, applying the model with both exercising conditions to this problem we obtain the results shown in Table 2 and Table 3.

Moreover, it is also possible to obtain a distribution from simulations for both NPV OW and Extended

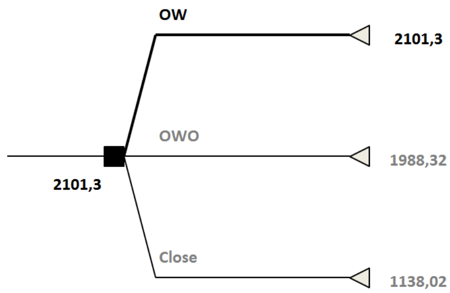

Figure 5: The figure shows three exclusive investment alternatives with their respective NPVs and, in red, the selected path which corresponds to the expansion alternative.

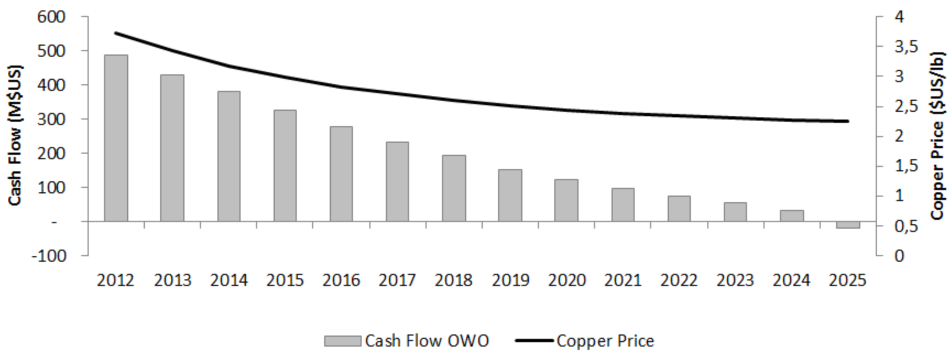

Figure 6: The figure shows the expected copper price and expected cash flows for alternative OWO.

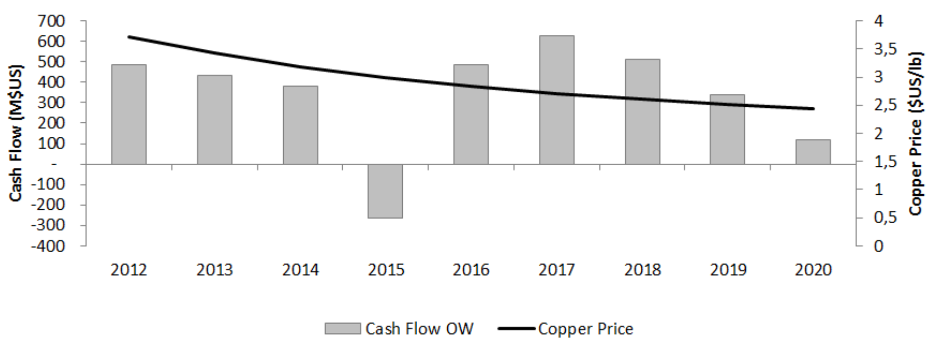

Figure 7: The figure shows the expected copper price and expected cash flows for alternative OW.

Extended NPV (M \$ US)	2167.01
Option Value (M\$US)	65.7

Table 2: Extended NPV associated and Option Value to the model applying the exercising condition 1

NPV for both exercising conditions. These distributions are shown in Figure 8, Figure 9 and Figure 10. Figures show that not only the mean of the valuation with flexibility is better than the valuation without flexibility, but also the risk associated is smaller since we are using a better way to invest that will work as

Extended NPV (M $ US)	2110.4
Exercise Price to Expand ($ US / lb)	2.32
Exercise Price to Close ($ US / lb)	0.8
Option Value (M$US)	9.1

Table 3: Extended NPV and Option Value associated to the model applying the exercising condition 2

a hedging strategy. The Table 4 shows the standard deviation for both projects.

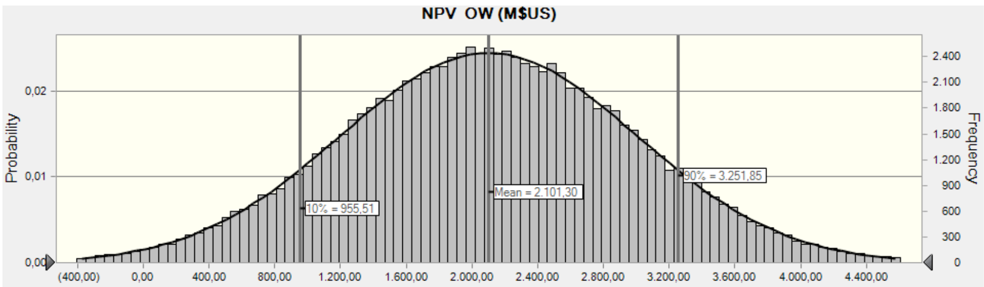

Figure 8: The figure shows the approximate distribution of the NPV OW applying DCF method, resulting in a lognormal distribution with mean M$US 2101.30 and with P10 and P90 equal to M$US 955.51 and M$US 3251.85 respectively.

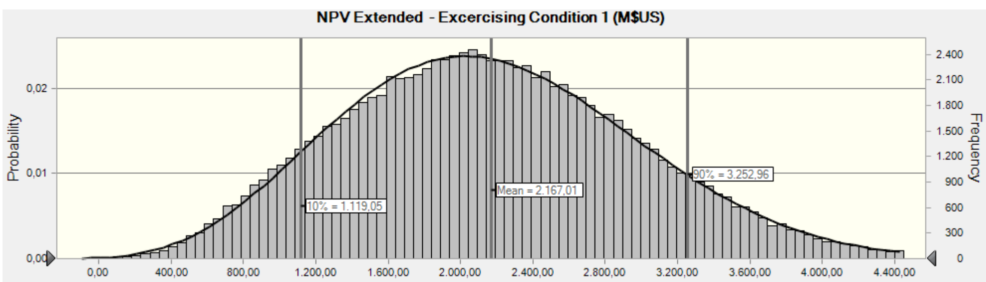

Figure 9: The figure shows the approximate distribution of the Expanded NPV applying the exercising condition 2, resulting in a lognormal distribution with mean M$US 2167.01 and with P10 and P90 equal to M$US 1119.05 and M$US 3252.96 respectively.

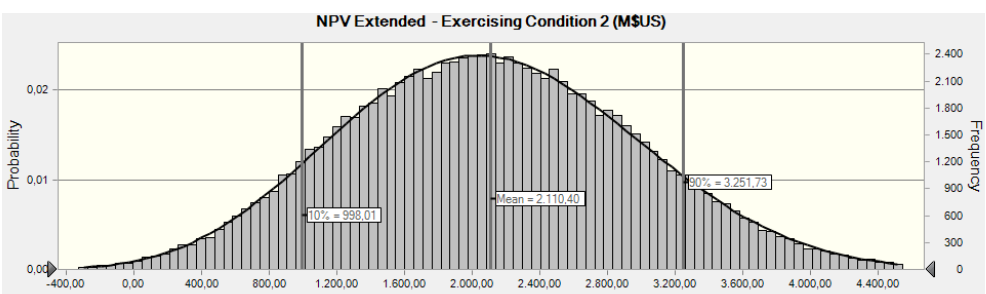

Figure 10: The figure shows the approximate distribution of the Expanded NPV applying the exercising condition 2, resulting in a lognormal distribution with mean M$US 2110.40 and with P10 and P90 equal to M$US 998.01 and M$US 3251.73 respectively.

Other interesting result is the quantity of times that each option is exercised for both exercising conditions

	Mean (M $ US)	**Standard Deviation** (M $ US)
Valuation without Flexibility	2101.3	888.27
Valuation with Flexibility -Ex. Condition 1	2167.01	863.67
Valuation with Flexibility -Ex. Condition 2	2110.40	809.54

Table 4: Mean and standard deviation of valuations without flexibility and with both exercising conditions

studied. These results are shown in Table 5.

Investment Alternative	**Exercising Condition 1**	**Exercising Condition 2**
OWO	28.6%	15.2 %
OW	66.4%	84.7 %
Close	4.8%	0.2 %

Table 5: The table shows the times, in percentage values, in which each option is exercised.

Finally, it is important to remark that option value can increase considerable when current scenario is not so good. In the case of copper we have seen strongly increments in prices which have keep them exceeding 4 $ US/lb. However, from one month to other, due to a crisis for instance, prices can drop strongly which produce significant changes in valuation .

To exemplify this point, suppose that current price is 3 $ US/lb instead 4.08 $ US/lb. With this initial price we note that the OWO has a NPV about M $ US 1419.4 and OW has a NPV about M $ US 1453.1. Thus, the expansion has a value about M $ US 33.68 which is about 30% of the value calculated initially.

Now, applying the model to the exercising condition 1, the option value is M $ US113.15 which is a 72% bigger than previous result. For the exercising condition 2 we obtain an option value of M $ US 30 which is about 333% of the previous result. However, in this case we find that both the exercise price to expand and to close are the same that calculated before. These facts can be explained because of as we are dealing with a mean reverting process, at $t_e = 4$ year (year 2015), prices achieves some stability and moreover, the regressions are affected for all the cases (OW, OWO and Close) with drop on NPVs.

Finally, Table 6 shows the quantity of times in which each options is exercised for both exercising conditions.

These results show a considerable change with respect to those computed when $P_0 = 4.08$ US$ /lb. It has an impact in the time in which option to expand is exercised, producing a decrease from 66.4% to 54%

Investment Alternative	Exercising Condition 1	Exercising Condition 2
OWO	36%	37%
OW	54%	62%
Close	10%	1%

Table 6: The table shows the times, in percentage values, in which each option is exercised supposing that P_0=3 US$/lb

for the exercising condition 1 and from 84.7% to 62% for the exercising condition 2. In the following section, a Volatility and Capex sensitivity analysis are made, aiming to find how these parameters can change the results obtained.

4. Sensitivity Analysis

It is important to know how real option valuation results can change when facing a variation in parameters inside the model. By considering variations in Price Volatility and Capex we will explain these changes in the results.

4.1. Sensitivity to Price Volatility

Price Volatility is a measure of price variations. From 2005 until now, commodity prices has shown a strong variation which motivates to study how volatility can change project risk and as a consequence, project planning. The analysis shown in what follows will allow an understanding of the impact on the results, and hopefully, be interesting to apply in other applications as well. Figure 11 shows percentage variations of options associated to both exercising conditions in function to percentage variation of volatility.

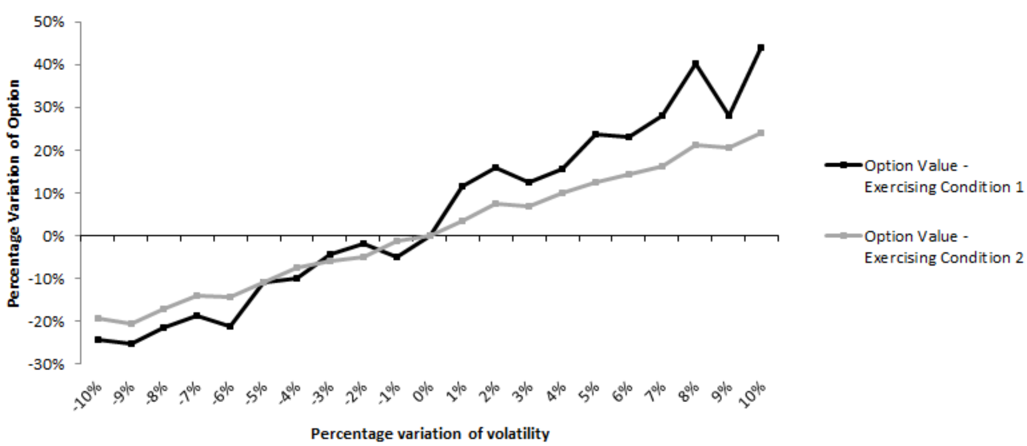

Figure 11: The figure shows the sensitivity of the option value for both exercising conditions facing change in volatility.

As it can be seen, the tendency is in accordance with the common intuition about the increase of the option value when volatility increases. It is also in agree with the Greek Vega [4] when we talk in the financial context. Moreover, we can see that even the tendency is the same for both exercising conditions, the option value is more sensible to changes in volatility when we use the exercising condition 2.

4.2. Sensitivity to Capex

Capex is particularly important in mining since high investment levels are made. These investments are made thinking in the execution of a good business alternative. However, the uncertainties can change what is initially considered as a good scenario. Moreover, it is not rare that at the moment an investment is made, changes are found in the Capex that was estimated in the first stages of the study, therefore it is important to know how this will modify the real option valuation results.

Figure 12 shows the variation changes in the option value for both exercising conditions when making variations in Capex. It is possible to observe an increasing relation between both variables when using Capex.

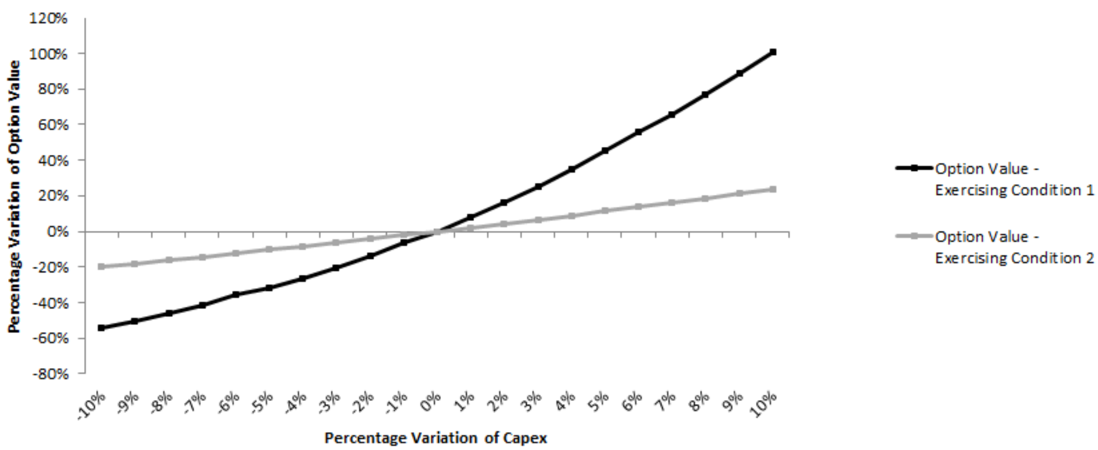

Figure 12: The figure shows the sensitivity of the option value for both exercising conditions facing change in Capex.

The increasing relationship between Capex and the option value is also intuitive. As a rise in Capex makes the project less desirable, facing bad price scenarios can be discarded via the expansion option in order to avoid worse scenarios in respect to smaller Capex levels. On the other hand, for the case of the exercising condition 2, we can see the sensitivity of the exercise price to expand when making variations in Capex. Figure 12 shows an increasing relationship between Capex and the Exercise Price. This fact is explained

[4] Vega is defined as the sensitivity of the price of an option to changes in volatility. It is measured by computing the derivative $\frac{dC}{d\sigma}$ which is positive (Where C represents the call option value)

since a rise in the Capex makes the project less desirable and then a better price scenario is required before deciding to expand.

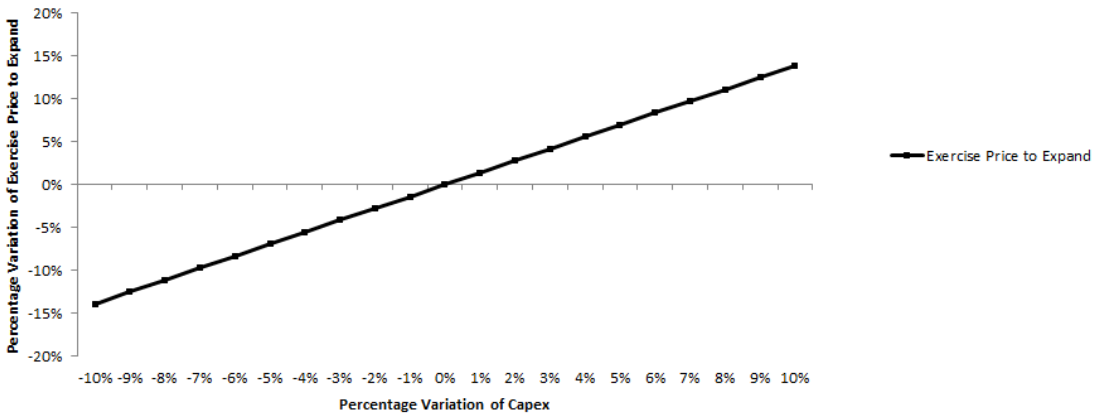

Figure 13: The figure shows the sensitivity of the exercise price to expand for both exercising conditions facing change in Capex.

5. Conclusions

This work proposes two ways to determine exercising conditions to value flexibilities in a single instant of time. The option value obtained by the exercising condition 1 is bigger than the option value obtained by the exercising condition 2. The reason is clear. The first exercising condition take always the greater remainder NPV and then it computes the Extended NPV choosing always the better alternative according with prices simulated. However, this exercising conditions assumes in each price path that in the time of taking decision there is not uncertainty in the future which is not adapted to reality.

On the other hand, the exercising conditions 2 estimates exercise prices. This approximation takes the mean behavior of the uncertainty from commodity price. It is for this reason that there are mistakes in the decision: Sometimes price can be high, fact that makes see a good future scenario but abruptly price drops when investment was ready made. However, this exercising condition re-creates in a better way what many companies must face considering eventual mistakes in decisions. Moreover, it gives a clear value to companies about what prices are good to exercise different options.

The application of the model to a copper mine shows how ROA can make growth the value of projects. Also, it was shown that when project are not good the option values increase significantly. This fact give us also an intuition about when the application of ROA is useful and when is not: If companies evaluate a project with low value so applying ROA is a good proceed to captures flexibility and increase the NPV and on the other hand, if project is good, ROA will not add a great value to NPV. In addition, the risk level drops which is always a desirable result.

An advantage of this model is that it is easily applicable for companies, since it does not require high computational and mathematical knowledge. Moreover, flexibilities dealing in this work are just some among many others. However, the model is limited to flexibilities that can be exercised in a single instant of time which ignores the value to other kinds of options as for instance to defer expansion.

Other strength of this model is that can be deal with real mine plans since it is just neccesary having the cash flow structure. Thus, it is not neccesary to make simplifications that many times can minimazie reality of projects.

Finally, it is possible to extend this application a multiple uncertainties such as multiple-factor price models, costs among others. In this case we can talk about hyperplanes of exercise instead intervals of exercise.

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Appendix

Mine Plan - OW		2012	2013	2014	2015	2016	2017	2018	2019	2020
Tonnes mined	'000 tpa	100.000	100.000	100.000	110.000	150.000	150.000	150.000	150.000	60.000
Ore mined to processe	'000 tpa	15.000	15.000	15.000	15.000	25.000	35.000	35.000	30.000	15.000
Proportion ore	%	15,00%	15,00%	15,00%	13,64%	16,67%	23,33%	23,33%	20,00%	25,00%
Head grade Cu	% w/w	1,33%	1,33%	1,33%	1,31%	1,21%	1,11%	1,02%	0,94%	0,86%
Recovery Cu	dimensionless	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7	0,7
Unit mining costs (Opex Only)	US$/t mined, real	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
Unit processing costs (Opex only)	US$/t processed, real	8,0	8,0	8,0	8,0	8,0	8,0	8,0	7,0	7,0
Fixed costs (opex only)	US$m, real	90,0	90,0	90,0	90,0	115,0	115,0	115,0	115,0	95,0
Sustaining Capex	US$million, real	10,0	10,0	10,0		10,0	10,0	10,0	10,0	10,0
Growth Capex	US$million, real	-	-	-	600,0	-	-	-	-	-
Total Capex (Before Tax)	US$million, real	10,0	10,0	10,0	600,0	10,0	10,0	10,0	10,0	10,0

Figure 14: The figure shows the Mine Plan to expand (OW)

Mine Plan - OWO		2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Tonnes mined		100.000	100.000	100.000	110.000	110.000	110.000	110.000	115.000	115.000	115.000	115.000	115.000	115.000	60.000
Ore mined to processe	tonnes	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	15.000	8.000
Proportion ore	%	15,00%	15,00%	15,00%	13,64%	13,64%	13,64%	13,64%	13,04%	13,04%	13,04%	13,04%	13,04%	13,04%	13,33%
Head grade Cu	% w/w	1,33%	1,33%	1,33%	1,31%	1,24%	1,18%	1,12%	1,06%	1,01%	0,96%	0,91%	0,87%	0,82%	0,78%
Recovery Cu	dimensionless	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73	0,73
Unit mining costs (Opex Only)	US$/t mined, real	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6	1,6
Unit processing costs (Opex only)	US$/t processed, real	8,0	8,0	8,0	8,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Fixed costs (opex only)	US$m, real	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0	90,0
Sustaining Capex	US$million, real	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0
Growth Capex	US$million, real	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Capex (Before Tax)	US$million, real	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0	10,0

Figure 15: The figure shows the current Mine Plan (OWO)