Real Option Technique for an Assessment of the Itakpe Iron Ore Project

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Abstract. This study examines the viability of an iron mining mineral with the approach of real options, which allows the mining project flexibility and scalability. A positive value for the Option to delay was achieved, which indicates the feasibility of the Itakpe project. In addition, the Option to abandon before the expiration of the project under unfavorable market conditions was obtained.

1. Introduction
There are numerous mineral resources in Nigeria, including bitumen, iron ore, lead, tar, limestone, natural gas. These mineral resources have added enormously to the socio-economic gains synonymous with national wealth [1-3]. The Associated Ores Mining Company (AOMC) was founded in 1979, as the Nigerian Iron Ores Mining Company (NIOMC) to oversee the iron ore project's affairs. Recently, thanks to the current administration's diversification of the Nigerian Economy, considerable focus has been given to the mining industry. The iron ore project's feasibility would be of concern to investors venturing into the iron ore business. The value of the project would be a crucial factor in making choices for investors [4-5].

In mathematical finance and option pricing practices, Pricing Models (PMs) are vital tools that apply specific variables to compute the theoretical value of an option. The theoretical estimation (value) of an option determines what the appropriate option worth using all available information. This is to say that option pricing tools (models) give a fair value of the options they represent. Finance practitioners may change their trading techniques and holdings if they have a better understanding of how the fair value(s) of an option is calculated [4-5]. Hence, option pricing models are compelling tools for finance specialists involved in options dealing. An option's intrinsic value is the value, or income, received by the holder by instantly executing the Option. The time-premium of the Option is its worth, or benefit, of being willing to wait and see.

Real options valuation (ROV), popularly referred to as real options analysis (ROA), uses option valuation methods for capital budgeting in terms of decision making [4, 6]. In a financial setting, a real option is a right—but never an obligation—to engage in specific business drives, such as staging, delaying, expanding, rejecting, or contracting a capital project investment [7]. Real options practices are especially significant for businesses with several fundamental features.

In literature, various studies have used the real options methodology to improve the value of mineral
The discounted cash flow's net present worth (value), the Option to delay, and the Option to abandon in the Itakpe iron ore mine project are determined in this article.

2. Discounted Cashflow
In order to estimate the feasibility of the Iron ore project, we have applied the conventional method of the Discount Cashflow (DCF) capital investment analysis. The project sustainability would be measured on the basis of projections of cash flow from prior revenue and costs over a five-year term. It is remarked that the Central Bank of Nigeria (CBN) is utilizing the new interest rate of $15 percent. The Net Present worth Value (NPV) of the project is denoted as:

$$NPV = \sum_{t=1}^{m} \frac{G_t}{(r+1)^t}$$

with $r$ as the discount rate, the time period as $t$ in years, and $G$ as the cash flow. In Table 1 below, we obtain a negative NPV, $-15608328.30$. Thus, the project is not worth investing in (by the DCF investment criteria).

| Table 1: Cash-flow |
|-------------------|
| **Cashflows**      | 2016(US$) | 2017(US$) | 2018(US$) | 2019(US$) | 2020(US$) | 2021(US$) |
|-------------------|-----------|-----------|-----------|-----------|-----------|-----------|
| Initial Capital   | 15929274  |           |           |           |           |           |
| Cash-inflows      | 537717.00 | 623644.00 | 723303.00 | 838887.00 | 972941.00 |           |
| Cash-outflows     | 226765.00 | 262829.00 | 304657.00 | 353169.00 | 409434.00 |           |
| Cashflows         | 310952.00 | 360815.00 | 418646.00 | 485718.00 | 563507.00 |           |
| Discount factor(15%) | 46642.80  | 54122.25  | 62796.90  | 72857.70  | 84526.05  |           |
| Present value of cashflow | 320945.70 |           |           |           |           |           |
| NPV               | -15608328.30 |           |           |           |           |           |

In the next section, the real options method is considered.

3.0 Overview of the Real Options Approach
Real options strategy is the concept of financial options for the valuation and assessment of real assets. A valuation method (formula) for financial options, referred to as the Black-Scholes model, was introduced by [13]. This has been applied for the valuation of real Option.

3.1 The Notion of Option to Delay
The decision to delay (wait) until the market economy recovers before making an investment is similar to the call option in the real options theory and practices. For the project, the investment cost denoted as $I$, $C$ implies the present value (PV) of the project's future cash flows, $r$ is the riskless interest rate and $t$ is the amount of years before the expiry of the Option is exercised. Note that in the Option to
delay, a firm that has, for instance, a patent right on a particular product possesses the right to develop and market the product exclusively until the patent expires. The firm will sell and create the product only if the present worth (value) of the expected cash flows emanating from the product's sales exceeds the development cost. If this does not happen, the firm can delay the patent and not incur any further charges (or costs). The delay option value is

\[ D_{\text{ave}} = CN(d_1) - Ie^{-rt}N(d_2) \]  

(2)

with

\[ d_1 = \frac{\ln\left( \frac{S}{K} \right) + \left( r + \frac{\sigma^2}{2} \right)t}{\sigma \sqrt{t}} \]

(3)

and

\[ d_2 = d_1 - \sigma \sqrt{t} \]

where \( \sigma \) implies the volatility term, \( N(d_1) \), and \( N(d_2) \) denote the probabilities based on the Gaussian distribution.

We considered a projected cash-flow from 2016-2021 for the Itapke ore project. The values for \( I, t, C \) and \( \sigma \) are 159,292,74, 5,320,945.7, and 0.75 respectively.

The value of the Option to delay of the Itakpe ore project was calculated to be $230,955.39. Since this value is more than the NPV, then the investment should wait before investing. Hence the Option should be exercised.

3.2 Option to Abandon

If the project's salvage worth approaches the worth of the project's expected cash flows, so the optimal Option would be to abandon the project. We presume that it was specified in the contract that after 4 years with a salvage value, \( S \), of 40% of the present worth (value) of the cash flows, the investor would abandon the project. Note that, over the lifetime of the Option to abandon, managers may have the possibility of halting a project and, likely, recognizing its salvage importance. In a case where the present worth (value) of the outstanding cash flows declines below the liquidation value, the commodity can be sold, and the exercise of a put option is essentially an operation. This Option is also regarded as the Option to terminate. There are American-styled abandonment solutions.

For the Option to abandon, the value of the project is:

\[ A_{\text{ave}} = Se^{-rt}N(1-d_2) - CN(1-d_1) \]  

(4)

Using the following criteria, we calculate the worth of the abandonment option: the salvage value, estimated cash-flows, riskless interest rate, and time are 128,378.28, 320,945.7, 0.75 and 4, respectively. The Option to abandon the project has a value of $154,189.5.

4. Conclusion

Due to averse business dynamics, inflation, government policy, and so on., the mining investment is defined with uncertainty and volatility. Valuing such investment using just the conventional process, such as DCF, does not yield optimum returns. In this article, we have used the real options technique to underline the reality. The findings obtained revealed the versatility inherent in the real options model.

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