Financial Risk Analysis on Coal Reserve Estimation

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Abstract: The economic feasibility is one of modifying factors that must be considered in the process of converting coal resources to coal reserves. Financial risk analysis is important to do on the application of economic modifying factors so that the correct declaration of coal reserves. The main factors that affect financially are changes in coal prices and mining costs. To resolve problem uncertainty financial risk used is IRR and sensitivity analysis methods. In this study, the discound factor used is 10% to obtain NPV 5.7 million, IRR 39%, and PBP 2.1 years with estimated coal reserves of 7.7 tons. Risk factors if there is a price decline of up to 3% more than that, the estimated coal reserves will be change.
Keywords: Modifying factors, Financial risk, coal reserve estimation

1. Introduction

The conversion from coal resources to coal reserves is influenced by modifying factors including considering mining, economic, marketing, processing, environmental, legal, social and governmental factors. The use of modifying factors is very basic and important in converting coal resources into coal reserves. If there is uncertainty from one of the modifying factors, it will have an impact on the level of confidence in the classification of coal inventories.

The economic factor is one of the modifying factors of conversion from resources to coal reserves. In this economic factor there are uncertainties or risks that must be analyzed include commodity prices, mining operating costs, currency exchange rates. Failure to properly investigate all relevant modifying factors can result incorect conversion of resources coal reserves, adding unnecessary risks to a project or even leading to premature closure of mine. To resolve uncertainty on financial risk analysis, we can use rate of return (IRR) method, settlement of cash flow and sensitivity analysis. In this research, it will be shown the relationship between the rate of return on capital is very influential on estimated volume of coal reserves.

2. Method

The reference used for coal reserves estimation in Indonesia is SNI 5015: 2011 referring to the Australian Guidelines for Estimating and Reporting on Inventory of Coal, Coal Resources, and Coal Reserves, 2003 Edition. In SNI SNI 5015: 2011, to convert from coal resources into coal reserves there are modifying factors, including considering mining, economic, marketing, processing, environmental, legal, social and government factors.

2.1. Economic Modifying Factor

The financial feasibility of a project is an important factor so that coal reserves can be declared, the project must be economically, and proving that the project is mineable [3**]**.

2.2. Risk Analysis

The procedure that is generally used to evaluate an investment project is to compare the benefits of a project with the costs incurred for the activity. The method used to evaluate is the net present

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value method of Net Present Value (NPV) and Benefit Cost Ratio (BCR). In all industries, an economic analysis is carried out to select projects that will provide the maximum value of available capital invested. To consider the selection of project economic decisions, various economic analysis techniques are used such as present value, annual value, future value, rate of return, or various break even analysis [4]. if these methods refer to the time value of money principle based on a compound interest rate (I *), the technique is called discounted cash flow analysis.

$$NPV = (\mathrm{F0}(\mathrm{P/F}, \mathrm{i} * \%, 0) + \sum_{j=1}^{n} Fj(\mathrm{P/F}, \mathrm{i} * \%, \mathrm{j}) \quad (1)$$

Where *Fo* is the capital expenditure, *Fj* is the cumulative net cash flow, P/F is the present value given future, *n* and *j* are the time (in year). If the NPV of the net cash flow is greater or equal to zero (≥ 0), then the alternatives can be considered.
The rate of return method is based on the fact that the gross income of a company is usually used for two purposes, namely to pay all costs and pay for capital usage based on a certain level of profit. For this reason, we need a level of capital withdrawal (i = ROR) from a cash flow that makes payments equivalent to receipts, based on a certain point of time (present, annual, or future).

$$\mathrm{NPV}_{@\mathrm{i}=\mathrm{ROR}} = 0, \text{ or } \mathrm{PW}_{@\mathrm{i}=\mathrm{ROR}} \text{ cost} = \mathrm{PW}_{@\mathrm{i}=\mathrm{ROR}} \text{ income} \quad (2)$$

Then to determine or calculate the cost of capital based on the portion of dept and equity of the company using the Weight Average Cost of Capital (WACC) method. This method is usually used to test the feasibility of investing in companies based on varied capital structures.
Then, to determine the discount rate (i*), the weighted average cost of capital (WACC) is used through capital asset pricing model (CAPM) method. The model can be seen in the equation below.

$$WACC = [Cd * (1 - tax) * D] + [Ce * E] \quad (3)$$

$$Cd = (r_f + r_p) * (1 - t) \quad (4)$$

$$Ce = r_f + \beta * (r_m - r_f) \quad (5)$$

Where Cd is the cost of debt, D is the debt ratio, E is the Equity ratio, rf is the risk-free rate, rp is risk-premium, t is the marginal tax rate, β is the risk slope, rm-rf is the market risk premium [5].
Sensitivity analysis used for to show how far profitability of investment is affected by variations in parameters that affect overall profitability. Sensitivity analysis uses the ceteris paribus approach (if other things are the same), which assumes changes only occur in one variable, while other variables are considered to be the same or fixed [2]. If the price of mining products increases, than coal low rank quality can be calculate as reserves. Sensitivity analysis is a critical

analysis of the factor that effect forecast results. An excample would be an examination of the effects of changes price and on the forecast cash flow of mining project [1].

3. Data Processing

The location of coal reserve estimation study in South Sumatera, one of the provinces in Indonesia. the location of the mine is 9.3 Km from the jetty, then from the coal jetty the barge will be pulled up to a large ship through the river as far as 320.4 Km. The coal to be estimated has an calorivic value (CV) is 5100 Kcal / Kg, total moisture (TM) 26%, total sulfur 0.8%, and Ash content 4%. The price of coal is $ 47.82 / Ton.

The coal reserve estimation step starts from a review of the results the work geology engineer is seam model and resources classification. The next step is to calculate the break event striping ratio and make pit optimization and determine pit design. Pit optimization stage has considered the changing factors starting from government, mining technical, economic, marketing, legal, and infrastructure, social cost, environmental cost, and processing costs.

If at that stage all the factors considered are appropriate then the pit design stage continues, at this stage technical, government, social, environmental, legal and infrastructure factors. While economic modifying factors consider the grade of the road as consideration for fuel optimization.

The mine scheduling and mine sequence stage, where at this stage the material balance simulation activities between the mined coal and overburden removal. This stage also recommends the equipment used to achieve the specified production targets. Economic considerations at this stage are on mining operating costs that arise due to equipment operation and overburden removal costs according to distance.

In the economic model stage, at this stage the researcher focuses on the financial risk analysis process. At this stage almost all modifying factors are considered as costs. At this stage what is considered is the process of preparing cash flow through NPV, IRR and PBP analysis. If at this stage they do not get satisfaction with the return on capital, the process will be returned to the minescheduling stage first. However, if the problem goes further then it is immediately returned to the pit optimization stage to consider other alternatives in financing. If the economic modeling stage is acceptable, the next step is to determine the classification and reserve estimation until reporting coal reserves. The estimated stages of coal reserves can be seen in Figure 1 flowchart reserve coal estimation below.

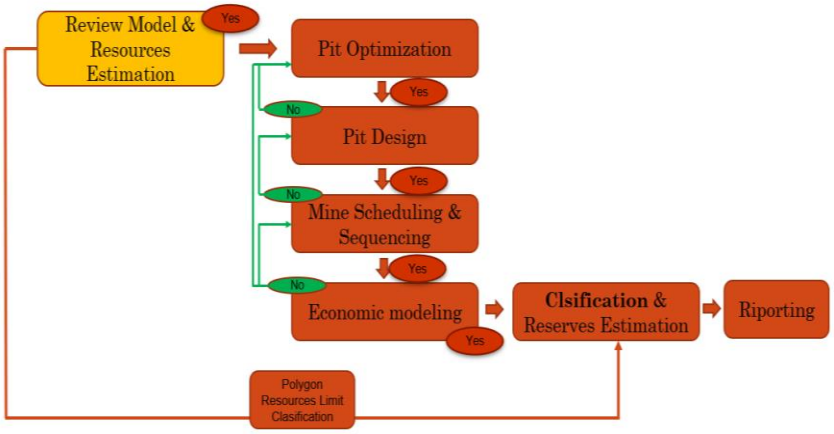

Fig. 1. Flowchart Reserve Coal Estimation

In the coal reserve estimation process that will be discussed in more depth is the consideration of economic modifying factors. The economic modifying factor starts at the pit optimization stage where the activity carried out is to simulate the determination of the pit limit by calculating the break even striping ratio. Costs that arise in the calculation of BESR are assumptions from factors that change the regulation of government, mining, environmental, social, processing and infrastructure costs. At this BESR stage, capital expenditure costs have not yet been included, these costs will be included in the economic modeling stage. The calculation can be seen in table 1 below.

Table. 1 Break Event Striping Ratio Calculation

No	Description	Unit Cost	Value	PPN	UC+PPN	Cost
1	Coal Price	$/Ton	47.82			
	Operation Cost					
2	OB Stripping	$/BCM	2.25	0.23	2.48	
3	Coal getting	$/Ton	1.25	0.13	1.38	1.38
4	Coal Hauling	$/Ton/Km	0.23	0.02	0.25	2.33
5	Coal Crushing	$/Ton	1.78		1.78	1.78
6	Coal Jetty to Tongkang	$/Ton	1.5		1.50	1.50
7	Coal Transport to Ship	$/Ton/Km	0.06	0.007	0.07	21.47
8	Coal Shipping	$/Ton	1.5	0.15	1.65	1.65
	Operation Cost 2					
9	Safety Cost	$/Ton	0.05		0.05	0.05
10	Environment Cost	$/Ton	0.5		0.50	0.50
	Admin Cost					
11	Overheads	% Revenue	1%			0.48
12	Sell Cost	% Revenue	0.50%			0.24
13	PPN Contraktor	% of activity	10%			
14	Community Development	$/Ton	0.5			0.5
15	Royalty	$/Ton	5%			2.39
	Coal Mine Cost					**34.26**
	OB Removal Cost					**2.48**
	BESR					**5.47**

From the table above it can be seen that the coal mine cost is $ 34.26 / ton and the cost of overburden removal is $ 2.48 / BCM. The calculation shows that the break event number is

5.47, meaning that if you make a mining design more than that number, you will incur losses. The value of the break event has not been included in the capital cost and discount rate. Furthermore, it enters the pit design stage until minescheduling and sequence with a 5 years life of mine (LOM).

The next stage is the economic model. The investment is to build infrastructure, hauling road, jetty, and purchase of mining equipment. Total investment at the beginning of the year was $ 17.41 million, with a financing structure of 60% debt and 40% equity. The annualy interest rate is 8% and repayment of debt is flat until 5 (five) years. Then the company performs the weighted average cost of capital (WACC) calculation which will be used as a discounted rate to determine the NPV and IRR. With the pre-determined financing structure, the Discount rate is 10% and the income tax rate is 25%. The above costs are entered into cash flow and get value NPV is $ 5.7 million, IRR 39% and PBP 2.1 years. Coal reserve estimation following the economic analysis used was 7.7 Tons of Milion.

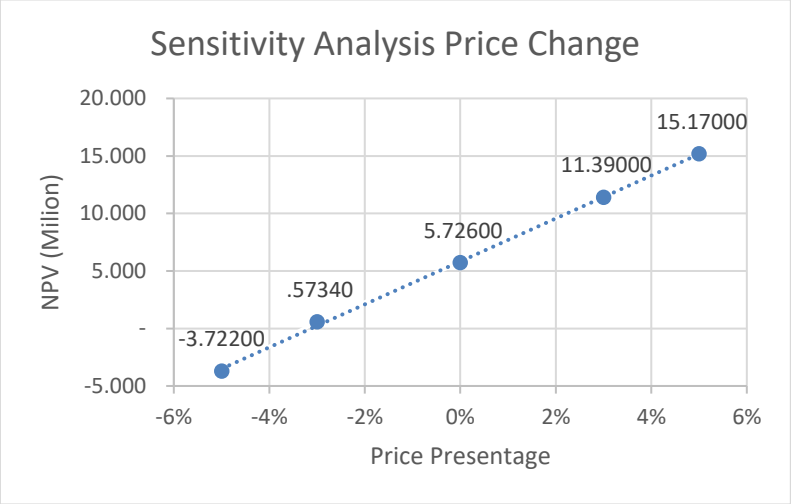

Fig. 2. Chart of NPV sensitivity analysis to price changes

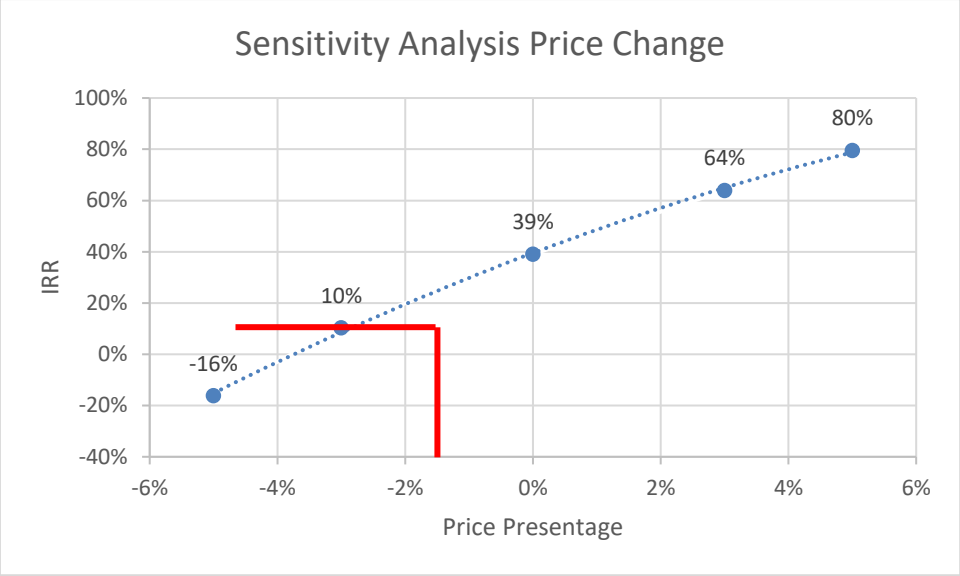

Fig. 3. Chart of IRR sensitivity analysis to price changes

From figures 2 and 3 it can be seen that price changes affect financial risk analysis so that it results in changes in the value of NPV and IRR. if there is a price decline allowed is at least the same as the discounted set of 10%. If more than that, the amount of coal reserves will be change.

4. Conclusion

The use of modifying factor greatly affects the results of coal reserve estimation, especially in economic factors where risk analysis is very determining the amount of coal reserves. Errors in estimating coal reserves could result in earlier close of mine and changes in Indonesia's coal reserve balance figures. If the price increases, the IRR and NPV will also increase and the possibility to increase reserves can be considered. If there is a decrease so that there is no change in the amount of reserves, the maximum price reduction will be 3%.

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