COMPOUND OPTION VALUATION FOR A COAL-BED METHANE DEVELOPMENT PROJECT

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Overview

Since 2008, a development of unconventional resources such as shale gas and coal-bed methane(CBM) has boomed due to technological improvement and high energy price. Recently, uncertainties of unconventional resources development is increasing because of a significant decline of global crude oil price. Because CBM distributed relatively equally around the world than conventional resource, to participate resource development is expected to easier for countries which has very low energy reserves like Korea and Japan, therefore it is still considered promising alternative resource. Therefore, an appropriate economic valuation is very important in an uncertain environment. However conventional economic evaluation method DCF assume a rigid situation so it can not consider uncertainties. There are many uncertainties in CBM projects; price fluctuation according to oil price, government incentives, the success rate of exploration, development life time, and water treatment options(Oh and Kim, 2013). Real option method can evaluate real assets properly by reflecting managerial flexibility in an uncertain environment(Yoo et al., 2011). In this study, real option approach was used to evaluate the investment for Indonesian CBM development project based on the previous research, "The feasibility study for coalbed methane in central Kalimantan, Indonesia"(KOPIA, 2008). CBM project consists of multi stage. We divided the stages and investigated each stage where each investment opportunity derives revenues from different technological uncertainties but share common market uncertainties. These multi stage real options involve interrelated investment opportunites in a compound options framework. As result, we extended binomial lattice to multi stage model to get a compound option value for a CBM development project.

Methods

In this study, compound real option were applied to Indonesian CBM project. This CBM project case is divided into two stages; Exploration stage, development and production stage. The period of exploration stage is 6 years. Development and production period is 24 years in this project. In order to develop a compound real option valuation model, we assume that there are sequential investment opportunities. The exploration investment provides the rights to invest development and production in year 6 if the exploration is successful. In development and production stage, a decision is determined yearly for 4 years. If there are uncertain environment during development and production, companies may wait for favorable circumstances. The C_2 is a 4 years American option and C1 is a 6 years European option. To value compound CBM option, we first start with the last Option C_2 and work backwards to value prior option C_1. Finally, the value of CBM project could be viewed as the value of a compound option with nested investment opportunities that can make future cash flows and other real options.

Table 1. Option type of CBM project

Option type/Variables	*CBM Option($C_{compound}$)*	*Exploration*	*Development and Production*
Type	Nested Real Call	Nested Real Call	Standard Real Call
Underlying Asset		Gross Project Value(V_1)	Gross Project Value(V_2)
Exercise Price		Investment(I_1)	Investment(I_2)
Time to maturity		6 years	4 years
Volatility		Volatility(σ_1)	Volatility(σ_2)

A binomial lattice approach were developed to estimate the option value of a CBM project. In the binomial lattice approach the gross project value V is assumed follow only two steps : uV with probability q or dV with probability (1-q). Also in order to develop each real option, we compute the risk neutral probability and determine the values for u and d(Cox J.C., 1996).

$$p = \frac{e^{r} - d}{u - d} \qquad d = \frac{1}{u} \qquad u = e^{\sigma}$$

Results

j \ i	Period						
	0	1	2	3	4	5	6
							226,608
						194,267	
					166,455		157,975
				142,556		134,928	
			122,036		115,207		107,203
		104,431		98,357		91,348	
State	89,343		83,980		77,933		71,490
		71,725		66,582		61,476	
			56,971		52,991		50,941
				45,784		44,545	
					39,025		40,624
						35,946	
							34,866

Fig 1. The result of binomial lattice model (Thousand USD)

For a compound option, the estimated option value was 89 million dollar. The value was higher than the value by using DCF. The NPV value by using conventional method was negative value, so project can not be executed. When applied compound option value to NPV value, total project value changed positive value.

Conclusions

There are a lot of uncertainties during CBM project. Especially, uncertainties of CBM project is increasing because of a recent decline of oil price. Also environmental regulation for CBM development is expected to be strengthened in Indonesia. Therefore, the economic feasibility analysis considering an uncertainty is essential. In this study, we could find out that the application of the real option for CBM project. It could provide useful information for the decision making for companies in uncertain situation. Total project value of applied compound option to NPV which was negative value changed positive value, CBM project could be executed. As a result, we could evaluate real CBM project assets value properly by reflecting managerial flexibility.

References

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