[*THE IMPACT OF GLOBAL OIL PRICE FLUCTUATION ON THE DEVELOPMENT BENEFIT OF COALBED METHANE IN SHANXI，CHINA*]

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Overview

Soaring demand for clean energy and more stringent environmental policies encourage China's largest coal producing province, Shanxi, to develop coal-bed methane（CBM） to serve the local markets. However, most of the CBM fields in Shanxi have poor permeability and gas content. The local CBM development is going through the period of a low single well output and a long investment recovery. Therefore, its ability to cope with changes in global oil prices is also relatively poor.

Although global oil price volatility cannot directly impact the benefits of CBM development, its recent fluctuations have had a certain impact on the investment costs and benefits of local CBM development in Shanxi. This paper analyzes the impact of global oil price volatility on the input and output factors of CBM development, so as to sort out the conduction path of oil price impact on development benefits. By selecting various statistical indicators, and using trend analysis, correlation analysis and regression analysis to quantify the impact of oil price on CBM development input and output; We select the net present value（NPV） as the benefit indicator, analyze the sensitivity of the NPV to each affected input and output factor, and quantify the importance of the affected factor to the development benefit. In the end, the result showsfor every 1% increase in the global oil price, the CBM development revenue decreases by 2.818%. The analysis shows that the main reason is the Chinese government's control over CBM prices.

Methods

The impact of oil prices on CBM development is reflected in the impact of oil price changes on local gas prices (The CBM price is the same as conventionnal gas price in Shanxi Province) , the impact on national and local subsidy policies, the indirect impact of fuel power,running cost and other costs in the development process through the price level. It is necessary to analyze the conduction mechanism of this effect, to clarify the conduction path of this effect（as fig 1）, and to calculate the actual size of this effect.

Changes in oil prices will have an impact on the following factors in the development of CBM: CBM prices, local market size of CBM, subsidies for CBM, fuel and power costs during development, sales expenses, and management service costs. Among them, CBM prices and fuel power costs are directly affected, and other factors are indirectly affected.

This article selects the ex-factory price index of oil and natural gas mining industry to measure the change of China's CBM price, GPPI for short; selects the total amount of natural gas consumption chain index as a measure of market size change, GCI for short; selects fixed asset investment price index to reflect the index of changes in land resource compensation fees and exploration and development investment , IPI for short; the industrial producer purchase price index (fuel power) is selected as the fuel power fee change index for CBM development, FPI for short. For the running cost part of operating costs, Wang(2016) Used EIA (Energy Information Administration) data for first-order differential regression, it is considered that 1% change in oil price leads to a change of running cost of oil and gas mining industry by 0.18%,this conclusion is adopted in this paper. For other operating costs, such as management expenses, sales expenses, workers Salary, etc., this article selects the consumer price index as a reflection index of other CBM operating costs, CPI for short; selects Brent annual average oil price, Dubai annual average oil price, WTI average oil price as global oil prices, calculate the mean chain index of the 3 global oil prices as the index to reflect the oil price fluctuation, OPI for short. It is Assumed that the CBM subsidy policy will remain stable in the short term.All data and indices are retrieved from the China Statistical Yearbook and the World Bank.A total of 12 years of data from 2006 to 2017 were selected for correlation analysis, and the linear correlation coefficient between the affected factor index and the oil price was calculated as the degree of impact. The calculation formula is as follows.

$$r（X,Y）=\frac{Cov（X,Y）}{\sqrt{Var[X]Var[Y]}}$$

In the above formula: X, Y are the sequence of variables, Cov(X, Y) is the covariance of X and Y, Var[X] is the variance of X, and Var[Y] is the variance of Y.

net present value (NPV) is selected as the final indicator of CBM development revenue.Its calculation formula is as follows:

$$NPV = R_s + R_b + R_t - I_k - I_z - I_y - I_d - C_t - C_j - C_l - C_i - T_x$$

In the above formula: R_s is sales income; R_b is subsidy income; R_t is after-sales tax rebate income; I_k is exploration investment; I_z is drilling engineering investment; I_y is fracturing engineering investment; I_d is investment in ground engineering construction; C_t is compensation for land resources; C_j is operating cost; C_l is loss of working capital; C_i is bank loans expense; T_x is the tax; all of the above are discounted values.

The degree of impact of each affected factors on the final development benefit is also different. Using the sensitivity of the NPV to each of the affected indicators to analysis, this paper argues that the more sensitive the factor is, The greater the NPV is affected. The sensitivity analysis chart is shown below as fig 2.
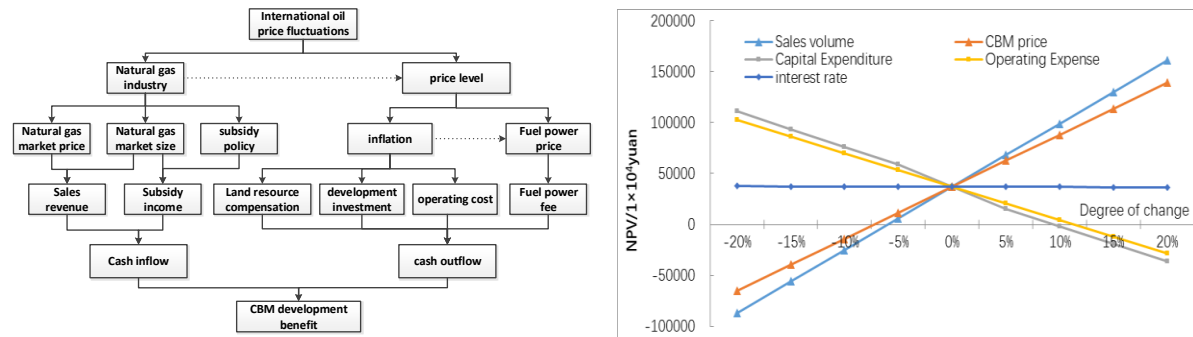

Fig.1 Transmission mechanism path of the impact of global oil price changes on CBM development benefits（left）
Fig.2 Sensitivity analysis of net present value on factors affected by oil price（right）

Results

Finally, the conduction path from oil price to various affected factors to final development benefit was established. The actual investment cost parameter of CBM development in Baode area of Shanxi was used as the calculation basis, and the influence degree of oil price change on CBM development benefit was calculated.

Table 1 The impact of oil price changes on the NPV of CBM development in Baode area, Shanxi china

oil price change （%）	+1		+1	+1			+1
Affected factor	CBM price		Construction Investment	Operating cost			Sales volume
Evaluation parameter	No reform	reform	Land resource compensation fee；Exploration and development investment	Fuel power fee	Running Cost	Other operating costs	Market size
Parameter index	GPPI	PPPI	IPI	FPI	/	CPI	GCI
proportion	/	/	/	6.35%	80.07%	14.58%	/
Degree of change	0%	0.34%	0.13%	0.17%			0
Degree of change in NPV	0%	4.682%	-1.318%	-1.499%			0%
NPV total	-2.818% , the non-reform scenario (NOW); +1.864%, the reform scenario (FUTURE)						

Conclusions

1. The impact of oil price on the development benefit of CBM is mainly reflected in the construction investment cost and operating cost. For every 1% increase in oil price, CBM development and construction investment in Shanxi Province increased by 0.13%, fuel power fee increased by 0.24%, operating cost increased by 0.18%, and other operating costs increased by 0.06%. The overall operating cost increased by 0.17%.

2. Surprisingly, If Shanxi does not have the natural gas price marketization reform in the future, a 1% increase in oil prices will result in a 2.818% drop in CBM development revenue. This is because the price of CBM in China is regulated by the government, and the fluctuation of global oil price has little impact on the price of natural gas in Shanxi Province. If Shanxi carries on the natural gas price marketization reform, and the CBM market price is linked to fuel prices, CBM development revenues will rise by 1.864% when global oil price rise by 1%.

3. For the local CBM development in Shanxi Province of China, with the premise of the current subsidy policy and price formulation policy, the recent decline in oil prices will benefit the development of the local CBM industry.