Effects of oil-price modelling approach on the economics of instruments to procure financial security for decommissioning

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Overview

Decommissioning of offshore oil and gas installations is becoming a central issue for the upstream industry in mature hydrocarbon basins such as the United Kingdom Continental Shelf (UKCS). One important challenge to decommissioning is the substantial amount of financial resources required. The Oil & Gas Authority (OGA) estimates that the cost to decommission the full inventory of UKCS offshore installations amounts to £51 billion (OGA, 2020). In the United Kingdom, the government has powers to require licensees to provide decommissioning security to protect funds in case of insolvency. Commonly used instruments are letters of credit and trust funds.

However, even if financial instruments are procured and appropriate plans are set out, oil price volatility has an important impact on decommissioning decisions. For example, the oil price collapse of 2014-2016 led operators in the UKCS to pay more attention to their levels of decommissioning security and how it is calculated (Holland & Davar, 2016). Notably, the Covid-19 pandemic has put further pressure on operators' cash flows in 2020 and 2021. The likely result is that the share of decommissioning costs will increase with respect to total costs and the industry will delay abandonment as much as possible (Kemp & Stephen, 2020).

In this paper, I focus on the effect that different real oil price modelling approaches have on the economics of two instruments to procure financial security for decommissioning liability: letters of credit and a trust fund. The study contributes to the literature in that it tests different approaches to model oil price and how it affects operators decisions under uncertainty relating to the use of instruments to procure financial security for decommissioning. The results are valuable for policy makers as well as licensees to understand the positive and negative features of using each model during their risk analysis, as well as the relative strengths of the the financial instruments.

Methods

The study is undertaken in two stages. First, four stochastic processes are used to simulate oil price paths: 1) random walk with drift, 2) geometric Brownian motion, 3) mean reversion (Ohrnstein-Uhlenbeck process), and 4) mean reversion with Jump. Studies of the time series properties of real oil price have found that it is best modelled as a stochastic process (Dixit & Pindyck, 1994). By contrast, there is no clear consensus as to the best type of stochastic process to use. Pindyck (1999) finds evidence of mean-reversion in real oil prices. On the other hand, Hamilton (2009) determines that the real price of oil follows a random walk. Dixit and Pindyck (1994, p. 78) suggest that geometric Brownian motion is a suitable approach to model real oil price because mean-reversion requires several data points to be statistically confirmed. Despite the differences, recent studies (Dvir & Rogoff, 2009; Kruse & Wegener, 2020; Rubaszek, 2020) assume mean reversion as the underpinning process and apply it to their models. In addition, the literature also considers Jump diffusion models (i.e. Poisson process). This type of model allows for infrequent but discrete jumps in oil price behaviour, for example, a sudden demand drop like the one from the Covid-19 pandemic or supply-side shocks like the Gulf War. See Lee et al. (2010) or Gronwald (2012) present evidence of such jump dynamics.

Second, a discounted cash flow model is built to analyse investment decisions of five oil fields designed to be representative of the UKCS. The simulated price paths from stage one are used as inputs in the financial model. The instruments under consideration are letters of credit and trust funds. The analysis centres on the following economic indicators for each field: net present value, tax paid, cessation of production date, total cost of the security

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instrument ,and the number of years paying security. Special emphasis is made on the cessation of production date and changes to decommissioning decisions.

Results

The main results of the analysis are used to determine: 1) the economic effects of using instruments to procure financial security for decommissioning in oil and gas projects, and 2) how the oil price modelling approach reflects uncertainty in the economics of the instruments and the project. A first key result is that by adding the cost of financial securities, the cessation of production date is brought forward compared to the cases without securities. The consequence is that the value of the project and tax paid is reduced. The second key result is that sudden negative changes in price paths increase the risk of the operator being unable to perform its decommissioning obligation as planned. This is especially true if the instrument used is a Trust Fund. If a price drop brings forward the economic limit, it is likely there will not be enough resources to carry the decommissioning duty. The third key expected result is that the degree of uncertainty incorporated in the model is higher for the mean-reversion with jump process.

Conclusions

This study is highly relevant both for practitioners engaging in economic appraisal and policy makers. For economic appraisal, it informs expected behaviour of economic criteria from using a certain modelling approach of oil prices. For example, an analyst may decide that the price path of a geometric Brownian motion is more relevant to its project because she does not requires the additional uncertainty introduced by the mean reversion with jump model. The results will also highlight the positive and negative features of procuring a letter of credit or a trust fund as decommissioning security. On the other hand, policy makers will find that certain instruments and uncertainty in oil price increase the possibility of operators not carrying out decommissioning obligations due to market conditions. Based on the results, they could issue guidance establishing the relative strengths of financial instruments as well as requiring operators to perform robust risk analysis to account for uncertainty in their economic appraisals.

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