

ECONOMIC ANALYSIS OF UNDISCOVERED PETROLEUM RESOURCES IN THE UNOPENED SEA AREAS OFF THE LOFOTEN ISLANDS IN NORTHERN NORWAY

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Abstract

Overview

Knowledge of a country's oil and gas resources and the expected economic value of these resources are essential for the Government and the Parliament (Storting) to formulate an effective petroleum-, energy- and economic policy.

Norway is the 5th largest oil exporter and 3rd largest gas exporter in the world. However, there are still large parts of the Norwegian Continental Shelf which the Norwegian Parliament has yet not opened for petroleum activities, including all of the northern Barents Sea and the sea areas off the Lofoten islands (NPD 2009). In Norway there is now a debate whether to open the sea areas off the Lofoten islands for petroleum activity or not. The economic effect of future offshore oil and gas development off the Lofoten area is an important element in the opening debate.

This paper describes and quantifies the expected and potential economic values based on the assessments of petroleum resources in the area.

Methods

The economic analysis is often done deterministic by calculating the value based on a mean development scenario (see Northern Economics (2009)). This method does not illustrate the resource and economic upside potential value of a decision to open up a new area for exploration.

We have used economic Monte Carlo simulation based on geological play analysis to calculate the economic value of the whole resource distribution. In evaluating petroleum exploration projects, Monte Carlo modeling is better than traditional deterministic calculations, gives a better estimate of the expected economic value for a skewed distribution which is common for resource distributions. of the expected economic value.

The resources or petroleum prospects are said to be "dependent" or "associated" if drilling success in one petroleum prospect increases the probability of success of others. This creates option-values that can be reached by sequential exploration of the dependent resources.

Stochastic dynamic programming techniques can be applied to identify the option-values created by sequential exploration of the dependent petroleum resources. That approach relies heavily on computational power but does not contribute much economic insight regarding the

elements of a successful sequential investment strategy. Of course, as the size of the portfolio of petroleum prospects grows, dynamic programming solutions impose ever larger computational demands and information requirements.

In this paper, along with the strategic management literature, we argue that it may be useful to employ a scenario-modeling approach to petroleum upstream projects when faced with high levels of uncertainty and sequential investments.

In order to illustrate our arguments, we combine scenario planning and Monte Carlo simulating techniques to value yet to find petroleum resources off the coast of the Lofoten islands in Norway. Combining economic Monte Carlo simulation based on geological play analysis with scenario analysis represents, in our view, a promising approach to estimating the economic value of undiscovered oil and gas resources in an unknown area.

Results

Due to the considerable uncertainty, and the fact that it will be possible to reduce uncertainty over time, the NPD has chosen to value the undiscovered petroleum resources by means of two methods; stochastic Monte Carlo simulating and scenario analysis.

The first method, a stochastic calculation based on the analysis of play models, takes into account the significant uncertainty of the resource distribution from the play model analysis, and calculates the expected value of the resources, and gives a present value distribution. Calculations show that there is practically a 90 per cent probability of positive profitability. The expected net present value has been calculated at around NOK 105 billion. There is a five per cent probability that the net present value will be NOK 180 billion or more. The stochastic calculation thus shows that the decision to explore is robust.

The stochastic model takes the uncertainty with regard to resource distribution into account, but does not fully take into consideration the fact that exploration and development would be taken step-by-step. New information would alter the optimum exploration and development strategy. This means that later decisions may serve to reduce the downside of the stochastic calculations and increase the upside, i.e. that the estimated uncertainty distribution for profitability, including expectations, underestimates the value of the petroleum resources in the areas.

In order to illustrate uncertainties with regard to resource volumes and enlight the additional values from step-by-step decision-making, a scenario analysis has been used in addition to the stochastic analysis. Values for four potential resource outcomes within the resource distribution from the play model analysis have been calculated. The different scenarios illustrate the range of the value. As a point of departure, each scenario is one of many potential sets of draws from the stochastic calculations (the number and size of discoveries and the type of hydrocarbon). The scenarios include optimizations such as drilling of fewer exploration wells, and more tailored development solutions and adaptations with regard to lead time. This entails that the value of the scenarios becomes higher than the value given by the stochastic model for an identical portfolio of discoveries. The net present value of the different scenarios varies between NOK 7 billion to around NOK 500 billion.

Since only two exploration wells have yet been drilled in the area, there is a great deal of uncertainty in the calculations. Therefore, it cannot be ruled out that the total resources will exceed the resource distribution in the NPD's play model analysis. A separate wild-card

scenario has therefore been added which is on the absolute extreme edge of the NPD's resource distribution, in order to reflect some of this uncertainty. The value of the resources in this scenario amounts to around NOK 650 billion.

The economic valuations show that there could be considerable petroleum resources and thus also huge values in the sea areas off Lofoten, Vesterålen and Senja. However, the values could be low, if the resource volumes are significantly lower than expected. A step-by-step exploration of the areas will in any case be a robust strategy to clarify the size of the resources that could be hidden out there, and the potential value that could be realised. Such a strategy begins with a wildcat well in the right place.

Conclusions

The analysis shows that there may be considerable values to be gained through production of the petroleum resources in the sea areas off Lofoten, Vesterålen and Senja. The value will be low if the resource volumes turn out to be significantly lower than expected. Step-by-step exploration of the areas will in any case serve as a robust strategy to clarify the potential volumes in the area, and to whether we have values that can be produced. Such a strategy would have to start with one or two carefully positioned wildcat wells.

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