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# Oil and Gas Exploration Success: An Econometric Assessment

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## Overview

The "Peak Oil" debate relates the current high oil prices to the global reserve situation. At the same time, the currently most important strategic challenge for international oil and gas companies also relates to reserve replacement. Oil and gas reserves in market-oriented economies like USA, Canada, United Kingdom and Norway are faced with depletion, and exploration activities are gradually redirected towards resource-rich regions of the world (e.g. Russia, Latin America, and the OPEC countries).

The reserve concept represents a differentiating factor of the production technology of oil and gas companies – as compared to other industries. Oil and gas companies have to engage in extremely risky exploration activities to support and grow their base of oil and gas reserves, and to sustain subsequent production activity over the longer term. Drilling efforts have been subject to a wide range of econometric studies since the mid 1960s, especially for the US (Dahl and Duggan, 1998). Less attention has been paid to the success and efficiency of oil and gas exploration, leaving a potential for further research. Mohn and Osmundsen (2006) show how the optimal schedule for reserve generation can be derived from the theory of producer behaviour through the application of duality principles in a restricted translog profit function framework. Explanatory variables include the oil price, available exploration acreage and accumulated discoveries. Reserve additions depend on drilling efforts, discovery rates and average discovery size. The economics of drilling efforts on the Norwegian Continental Shelf (NCS) was studied by Mohn and Osmundsen (2006). This paper augments the analysis, focusing on the productivity of drilling efforts.

## Methods

Our study is based on detailed database information from the Norwegian Petroleum Directorate. A unique data set has been developed for three separate regions of the Norwegian Continental Shelf (NCS) , and covers the full history of oil and gas exploration on the NCS (1966-2004). Due to the non-stationary properties of our data set, we apply co-integration techniques (Engle and Granger, 1987), and estimate dynamic error-correction models for, discovery rates, average discovery size, as well as combinations of these variables, like average resource addition per exploration well – or total drilling productivity.

## Results

We establish statistical links between exploration success on one hand, and technological change, accumulated discoveries, licensed exploration acreage and seismic surveying activity on the other. An oil price increase stimulates exploration efficiency, according to our results. A likely explanation is that oil and gas companies take higher exploration risk in periods with high oil prices, resulting in higher average discovery size. Major discoveries have a negative impact on subsequent discovery rates. However, total exploration efficiency responds positively to major discoveries, as the expected average discovery size will increase when new large oil and gas fields are discovered. Licensing rounds also tend to increase the average expected discovery size in our models, but these effects are not precisely estimated. We find that seismic surveying activities increase the discovery rate, whereas expected discovery size is negatively linked to seismic surveying activities.

Finally, a time trend captures technological progress in discovery rates. On the other hand, total drilling efficiency takes a negative estimated for the time trend. This result fits well with the downward trend in exploration results over the last 15 years, suggesting that the NCS gradually enters a more mature phase.

## Conclusion

Understanding the economics of oil and gas exploration is crucial to provide a complete representation of oil and gas supply. The current market and industrial environment does not make these issues less urgent. Oil prices are record-high, and price expectations do not suggest a normalisation to historical averages. "Peak Oil" concerns make their way into the public debate on energy issues. Reserve-replacement represents the most important strategic issue among international oil and gas companies – as market-oriented oil and gas provinces in USA, Canada and United Kingdom are maturing rapidly. Our econometric model provides a framework for specific analysis of exploration behaviour, including effects of oil price changes, exploration success and licensing policies. The effects are plausible, both in terms of sign and magnitude. NCS data suggests that the most material contributions to total resource growth work via exploration efficiency. Exploration activity is less responsive to changes in explanatory variables (Mohn and Osmundsen 2006). The results establish a structural relation between exploration efficiency, accumulated discoveries, exploration acreage and seismic surveying activity. Our model also provides new insights on the dynamics and sluggishness of oil and gas exploration, based on data from the Norwegian Continental Shelf. These insights are useful both for companies and policy-makers, as oil and gas investment now find their way into new regions, where the degree of regulation and government intervention is higher than Western oil and gas companies traditionally have been used to.

## References

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