EXPLORATION INVESTMENT ON THE NORWEGIAN CONTINENTAL SHELF

Sindre Lorentzen, University of Stavanger, Department of Industrial Economics and Risk Management, NO-4036, Stavanger, Norway, +47 51832247, sindre.lorentzen@uis.no

Petter Osmundsen, University of Stavanger, Department of Industrial Economics and Risk Management, NO-4036, Stavanger, Norway, +47 51831568, petter.osmundsens@uis.no

Overview

Reserve replacement is a key challenge for oil and gas companies. Much research has been devoted to optimal decision making regarding exploration effort. Less attention has been dedicated to empirical investigation of exploration costs. Our research aims at offering an econometric model for forecasting and explaining exploration costs in the oil and gas industry on the Norwegian Continental Shelf (NCS). Our study is solely focused on explaining costs related to exploration drilling. Other exploration activities, e.g. seismic surveys, is used as explanatory variables for exploration drilling.

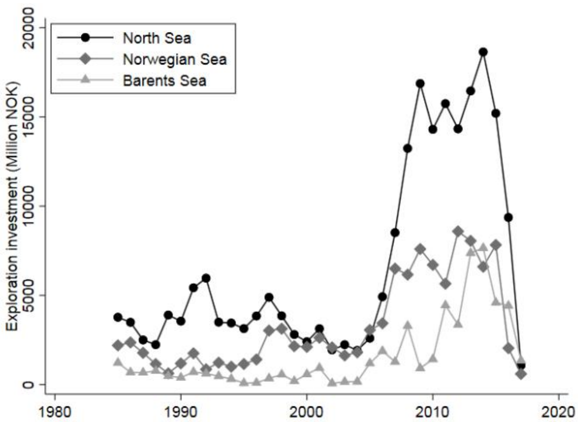

Figure: Exploration investment on NCS, 1985-2016. Data source: Norwegian Petroleum Directorate

In an article addressing an earlier period on the NCS, Mohn and Osmundsen (2008) investigate determinants of exploration effort (number of exploration wells - wildcats and appraisal) on the NCS, using oil price, discoveries, and available exploration acreage as explanatory variables. Our research complements this research. The focus is changed from exploration effort to the cost of exploration, and additional explanatory variables are considered (rig rates, seismic surveys, drilling speed, etc). We allow for inertia. No contemporaneous information is used, so the model can be used for forecasting. We have been able to obtain a higher explanatory power than Mohn and Osmundsen; R^2 is increased from 0.51 to 0.75.

Methods

The dataset is structured as a panel, i.e. exploration drilling costs are observed annually between 1985 and 2016 across different regions on the NCS; the North Sea, the Norwegian Sea, and the Barents Sea. The list of explanatory variables contains 11 items: crude oil price, realized volatility of the oil price, rig rates, reserve depletion, acreage awarded, acreage announced, the amount of seismic activity (2D, 3D and 4D), drilling speed, and discoveries. Investment cost of exploration drilling is modelled with fixed effect panel data regression, allowing us to control for certain unobservable variables. The model is specified by applying a specific-to-general (forward selection) approach - i.e. not all relevant variables are selected but only the variables that perform best according to our selection criteria. This approach is useful in this case where potential explanatory variables suffer from (imperfect) multicollinearity, and it ensures a good trade-off between parsimony and explanatory power.

Results

Our forward selection procedure specifies the optimal model to contain the following three variables: first lag of oil price (USD/bbl), first lag of drilling speed of appraisal wells (metre drilled per day), and first lag of discovery (number of exploration wells not classified as a dry well):

$$\begin{aligned} ExplorationDrilling_{it} &= \alpha + \beta_1 OilPrice_{t-1} + \beta_2 DrillingSpeedAppraisal_{it-1} \\ &+ \beta_3 Discovery_{it-1} + \varepsilon_{it-1} \end{aligned} \tag{1}$$

Variables such as *rig rate* perform well in a univariate setting, but is not selected due to high correlation with oil price - i.e. imperfect multicollinearity. Oil price is highly correlated with rig rates, wages, employment, etc (Dahl et al, 2017; Lorentzen et al, 2017). The oil price here serves as a proxy for other business cycle variables. No higher order lags were selected, suggesting that oil and gas companies adjust quickly when it comes to exploration.

Conclusions

A forecast of overall exploration cost will have to model both the exploration level (the number of wells) and the exploration cost (cost per well), where the former depends on geology, the cost per well and revenue. Our econometric forecasting procedure selects three variables to represent these three figures, with discoveries representing the geology, drilling speed representing the cost per well and the oil price representing revenue.

We find that an increase in oil price is associated with an increase in exploration drilling cost next year, as expected. An increase in drilling speed, is associated with a decrease in exploration drilling costs next year. Higher drilling speed implies less drilling time, calling for lower drilling cost. At the same time, lower drilling cost induces higher exploration effort, that calls for higher drilling cost. We find that the former effect dominates. An increase in number of discoveries is associated with an increase in exploration drilling costs next period. Success or failure of exploration wells cause information spillovers. A successful well, signals that additional wells may yield more discoveries to the extent that a region shares the same hydrocarbon-bearing geological features (Levitt, 2016) and may thus induce higher exploration effort.

References

Dahl, R.E., Lorentzen, S., Oglend, A. and Osmundsen, P., 2017. Pro-cyclical petroleum investments and cost overruns in Norway. Energy Policy, 100, pp.68-78.

Levitt, C.J., 2016. Information spillovers in onshore oil and gas exploration. Resource and Energy Economics, 45, pp.80-98.

Lorentzen, S., Oglend, A. and Osmundsen, P., 2017. Cost overruns on the Norwegian continental shelf: the element of surprise. Energy.

Mohn, K. and Osmundsen, P., 2008. Exploration economics in a regulated petroleum province: the case of the Norwegian Continental Shelf. Energy Economics, 30(2), pp.303-320.