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DRILLING SPEED – THE RELEVANCE OF EXPERIENCE

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OVERVIEW

Offshore exploration drilling requires large investments. Since day rates are high in offshore drilling operations productivity in terms of meters drilled per day has a significant influence on exploration investment costs. In this study we analyze the effect of different types of experience or learning on drilling productivity. The empirical analysis employs a large data set on individual exploration wells on the Norwegian Continental Shelf (NCS). In recent years oil companies have frequently experienced low productivity when drilling exploration wells on the NCS. This may have a negative effect on the number of exploration wells that oil companies decide to drill, and thus the ability to discover new petroleum resources to replace the declining reserves in developed fields.

Iledare and Pulsipher (1999) [2] and Managi *et al*. (2005) [4] are among the few studies of drilling productivity. It is hard to find empirical statistical evidence on the effects of different types of learning on drilling productivity, with an exception for Kellog (2007) [3], who analyze inter-firm learning in Texas onshore drilling. In our econometric analysis we distinguish between the following types of learning: (1) Previous drilling experience in a given area (quadrant); (2) previous experience of the operator (oil company) on the NCS; and (3) previous experience of the drilling facility on the NCS. These three types of experience are measured by the cumulative number of exploration and production wells drilled before the current well. In addition, we control for physical characteristics of the well and other well characteristics.

METHODS

We estimate an econometric model with drilled meters per day as dependent variable using observations of 519 wells from the Norwegian Petroleum Directorate (NPD). The model is specified with a translog functional form, which means that we allow elasticity measures to vary in explanatory variables. It is estimated using OLS with White's heteroskedasticity-consistent standard errors (White, 1980 [5]).

RESULTS

Table 1 reports calculated sample mean elasticities of variables of interest based on the estimated econometric translog model. Our main interest in this paper are which types of experience that influence drilling productivity. According to table 1 the mean elasticity of drilling productivity in quadrant experience is -4.6%. This may seem counterintuitive, but according to industry specialists may have a reasonable explanation. When increasing the drilling activity in a quadrant a negative effect on productivity related to the fact that the least challenging wells are drilled first (stock effect), and a negative effect related to negative congestion externalities that increases with the density of wells in a area. Our results suggest that the negative effects dominate positive learning effects. Previous experience of the actual oil company is found to have a positive effect on productivity, with an estimated mean elasticity of 5.7%, while for previous experience of the actual drilling facility we find no significant effect.

Table 1. Sample Mean Elasticity Estimates

Elasticity	Variable	Mean	Std, Err.	t-value	P-value
ε_{Ywd}	Water depth	-0.187	0.033	-5.660	0.000
ε_{Ydm}	Well depth	-0.130	0.078	-1.680	0.094
ε_{Ymd}	Max density of the drilling fluid	-0.603	0.225	-2.680	0.008
ε_{Ysd}	Variation in drilling fluid density	-0.081	0.037	-2.210	0.027
ε_{Yt}	Technical change	0.030	0.006	5.330	0.000
ε_{Yp}	Oil price	-0.416	0.083	-5.000	0.000
ε_{Yexq}	Quadrant experience	-0.046	0.015	-3.050	0.002
ε_{Yexog}	Oil company experience	0.057	0.026	2.150	0.032
ε_{Yexf}	Facility experience	-0.010	0.021	-0.460	0.647

According to table 1 drilling productivity is lower on average in deeper wells. The litostatic pressure, measured by the maximal density of the drilling fluid, is also found to slow down drilling productivity. Furthermore, pressure variations, are found to have a negative effect of productivity. This is in accordance with earlier studies that find that pressure variations may lead to a fatigue effect on boreholes, as the static pressure decline (Aadnøy, 1999 [1]). According to table 1 technological progress is highly significant with a yearly productivity increase of 3% alone. The technological progress is a result of frequent innovations, which without doubt have affected drilling technology, e.g., the introductions of the top drive and measurement while drilling. High oil prices have a negative effect on productivity. This is as expected since high oil prices are associated with high activity levels and thus a scarcity of qualified labor, high quality drilling facilities and other specialized inputs.

CONCLUSIONS

This paper has focused on the effects of different types of learning on exploration drilling productivity. We find that only oil company experience has a positive effect on productivity. Our estimated elasticity measure of experience in a particular area (quadrant experience) shows a negative effect on productivity, suggesting that congestion externalities probably dominate learning effects. The experience of the drilling facility is found to have no significant effect on productivity. Overall, our results indicate that also in the future will the physical well characteristics be important determinants of exploration productivity relative to learning effects.

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