MODELLING AND FORECASTING RIG RATES ON THE NORWEGIAN CONTINENTAL SHELF

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Overview

Knowledge about rig markets is crucial for understanding the global oil market. In this paper we first develop a simple bargaining model for rig markets. Then we examine empirically the most important drivers for rig rate formation of floaters operating at the Norwegian Continental Shelf in the period 1991q4 to 2013q4. We use reduced form time series models with two equations and report conditional point and bootstrapped interval forecasts for rig rates and capacity utilization for the period 2016q1 to 2018q4. We then consider two alternative simulations to examine how the oil price and remaining petroleum reserves influence rig rate formation of floaters. In the first alternative simulation we assume that the real oil price increases (in 2010 prices) from about 45 USD per barrel in 2016q1 to 80 USD in 2018q4, whereas the oil price in the reference case increases from about 30 USD to about 44 USD in real terms According to our results, the rig rates will be about 30 percent higher in 2018q4 with the higher oil price. In the second alternative simulation we explore the effects of opening the Barents Sea and areas around Jan Mayen for petroleum activity. This contributes to dampening the fall in the rig rates and capacity utilization over the last part of the forecast period.

Methods

Reduced form econometric models for quarterly time series with two endogenous variables are estimated. The two response variables are the mean of log rig rates and the capacity utilization rate of the North Atlantic area. The equation for the former variable is non-linear in one of the parameters, stemming from the lag specification of the oil price. Consistent estimates of the unknown parameters of the model may be obtained using single equation estimation methods, but, in view of a gain in asymptotic efficiency, we employ multivariate non-linear least squares, i.e., both equations are estimated simultaneously.

Our reference model is used for conditional forecasting. Besides a reference case, we consider two alternative simulations, which, respectively, deviate from the reference case with respect to (i) the assumptions with respect to oil prices in real terms and (ii) the assumptions with respect to petroleum reserves. To assess forecast uncertainty stemming from the errors of the model, bootstrapping, utilizing within-sample residuals, is utilized. The two endogenous variables are forecasted for the period 2016q1-2018q4.

Results

The log of the smoothed oil price, where the smoothing parameter is obtained as the estimate of one of the parameters, only enters the equation of the mean of log rig rates. The estimate of the smoothing parameter suggests that the expectations about future oil prices are updated quite fast to new oil price observations. For example, the oil price three years ago weighs roughly one quarter of the present oil price in the Koyck lag specification.

Also a lagged real interest rate impacts the rig rate positively. A one percentage point increase in the lagged real interest rate leads to a 0.078 increase in the log rig rate. In the theory model we found that the real interest rate has an ambiguous effect on the rig rate. The reason is that the real interest rate increases the capital cost of oil companies, making them less willing to pay for rigs, and increases the rig contractors' capital costs and hence the cost of supplying rigs. The positive estimate suggests that the rig contractor capital cost effect dominates.

The lagged (antilog transformed) capacity utilization rate is yet another variable that has a positive impact on the rig rate. This is as expected, because higher capacity utilization increases both the bargaining power of the rig contractors and the cost of supplying rigs (e.g., because of maintenance requirements). The same is true for the lagged lead time variable. We observe that a longer lead time suggests more pressure in the rig market, and thus has similar effects on the rig rate as capacity utilization.

We also find a significant positive effect of the lagged stock of remaining petroleum reserves (log-transformed). Intuitively, more available resources imply larger profit potential for the oil companies, and hence increased rig demand.

The most significant variable in the reduced form equation of the logit transformed capacity utilization is the lagged left-hand side variable, which enters with an estimate of 0.81. Thus, there is a high degree of persistence. Another significant variable is the (log) maximal drilling depth, depth, which enters positively and with an estimate that is not far from unity. The reference model seems reasonably well specified.

According to the reference simulation, the rig rate is predicted to fall from the beginning of 2016 to the end of 2018. The rig rate is predicted to fall by 26 per cent. The capacity utilization is predicted to increase by about 7percentage points. A major factor behind this drop in the rig rate is the substantial fall in the oil price (in constant prices), even if this fall is somewhat dampened since we use a smoothed oil price as an explanatory variable. The estimated capacity utilization equation is dominated by an autoregressive slope coefficient somewhat below unity and a positive seasonal effect related to the second quarter. This former term contributes to a reduction in the capacity utilization during the forecast period, whereas the latter works in the opposite direction When forecasting with the reference model we represent forecast uncertainty with 50% forecast intervals. The forecast intervals for the rig rate are rather wide. In 2018q4, the last quarter that we consider, the calculated forecast interval of the rig rate starts at 199 thousand USD (in 2010 prices) per day and ends at 266 thousand. The corresponding values for the capacity utilization are 0.74 and 0.94.

In the Higher oil price simulation we assume another (higher) path of the oil price by letting it grow from about 45USD per barrel (in constant 2010 prices) in 2016q1 to 80 USD in the ultimate forecast period 2018q4. Accordingly, the rig rate is about 30 per cent higher in 2018q4 in this alternative simulation than in the reference simulation In the Larger reserves simulation we are looking at the implications on the NCS rig market following opening for petroleum activity in the Barents Sea and areas around Jan Mayen. The associated increase in petroleum reserves (measured in 2018q4) is 12.3 percent, relative to the reference simulation. In this simulation the real rig rate is about 8 per cent higher in 2018q4 than in the reference case. The capacity utilization is about 5 percent point higher in 2018q4in this alternative simulation than in the reference simulation, since an increase in the petroleum reserves gives positive impulse to the capacity utilization.

Conclusions

In this paper we first presented a simple theoretical model to sharpen our understanding of rig markets and help identify the most important drivers for rig rate formation. Then we estimated their effects in the NCS rig market for floaters, using a reduced form two-equation econometric model for rig rates and a proxy for capacity utilization over the period 1991q4 to 2013q4. Last, we presented point and interval forecasts for rig rates on the NCS and capacity utilization in the North Atlantic area in a reference simulation and point forecasts for two alternative simulations. The first alternative simulation featured a relatively higher real oil price path, and the second involved opening for petroleum activity in new areas.

Based on the assumption of adaptive oil price expectations according to the Koyck lag structure, we found that expectations about future oil prices are updated quite fast to new oil price observations. In particular, higher oil prices stimulate petroleum development projects. The rig rates then increase because rig operators capture a share of the profitability from petroleum activity. On the other hand, we were not able to find a significant positive effect of real oil prices on capacity utilization. We found some evidence that increased remaining petroleum reserves stimulate rig rates and capacity utilization. Lastly, we found significant effects of two rig classification variables and maximum drilling depth. These are again roughly in line with the theory.

In the second alternative simulation we analyzed effects on the NCS rig market following opening for petroleum activity in the Barents Sea and around Jan Mayen. As expected, this induced higher rig rates and capacity utilization, as compared with the reference simulation. Rig rates decline over time in this simulation too, because the sharp decline in the oil price dominates the effect from increased petroleum reserves.