

# ***HOW FLEXIBLE IS U.S. SHALE OIL? EVIDENCE FROM NORTH DAKOTA***

Frode Martin Nordvik, BI Norwegian Business School, Centre for Applied Macro and Petroleum economics. Phone +47 92864028, E-mail: [frode.m.nordvik@bi.no](mailto:frode.m.nordvik@bi.no)

Hilde.C. Bjørnland, BI Norwegian Business School, Centre for Applied Macro and Petroleum economics. Phone +47 46419767, E-mail: [hilde.c.bjornland@bi.no](mailto:hilde.c.bjornland@bi.no)

Maximilian Rohrer, BI Norwegian Business School. Phone +47 46410581, E-mail: [maximilian.rohrer@bi.no](mailto:maximilian.rohrer@bi.no)

## **Overview**

In the second half of 2014, the price of oil plunged, partly as a result of the robust supply growth from US shale oil. These events have spurred renewed interest in the dynamics of oil production, in particular, to what extent producers in unconventional shale oil pools will respond to the negative price incentives by reducing oil production and drilling activity. Previous studies addressing the issue typically analyze aggregate output responses from conventional oil pools only, and commonly find oil production to be price inelastic in the short run (see e.g. Anderson et al. (2014), Griffin (1986) and Dahl et al. (1996).

However, aggregate elasticity of oil supply depends on the extraction technology of the marginal producer of crude oil. Today's marginal producers are US shale oil firms. At this time, oil production from shale deposits accounts for half of US total crude oil output, and the use of hydraulic fracturing technology is likely to spread to other oil producing countries, potentially making unconventional oil a much larger share of total production than it is today. Hence, knowledge of price elasticity in unconventional shale oil production is important, but lacking.

We aim to fill this gap by examining the short-term response of unconventional and conventional crude oil wells to short-term price changes. Using a novel and rich monthly panel data set from 1974 to 2015, covering more than 16,000 oil wells, both conventional and unconventional in the North Dakota oil patch, we are able to study the response of crude oil wells along two margins. Along the extensive margin, we ask if completion of new wells is sensitive to price changes, distinguishing between conventional and unconventional oil wells. On the intensive margin, we ask if the flow rate from existing wells respond significantly to innovations in prices, and compare the two types of well technology.

## **Methods**

Panel data

## **Results**

We find crude oil output from unconventional shale oil wells to respond three to four times as strongly to oil price changes as conventional wells.

Also, contrary to conventional wells, the monthly number of completed shale wells reacts strongly to changes in the slope of the future curve, but not to spot prices. For a 10 percent increase in the 12 month calendar spread, fracking producers immediately hold back 75,000 barrels of crude oil, effectively storing it underground, awaiting the higher expected price. One important mechanism behind this result is that the highly front-loaded production profile of unconventional shale oil wells increases firms' economic incentives to optimize the timing of completion, in response to changing short-term market conditions.

## **Conclusions**

We find crude oil output from unconventional shale oil wells to respond three to four times as strongly to oil price changes as conventional wells, which is a new finding in the literature. Good estimates of supply elasticity for shale oil are important because shale oil by now accounts for half of US total oil production, and so the extraction technology matters for aggregate elasticity. In addition, several countries outside the US are in the process of developing their shale oil reserves. In addition, supply elasticity matters for tax policy makers.

## References

Anderson, Soren T., Ryan Kellogg, and Stephen W. Salant. *Hotelling under pressure*. No. w20280. National Bureau of Economic Research, 2014.

Griffin, James M., and David J. Teece. "OPEC behavior and world oil prices." (1986).

Dahl, Carol, and Thomas E. Duggan. "US energy product supply elasticities: A survey and application to the US oil market." *Resource and Energy Economics* 18.3 (1996): 243-263.