DECLINE RATES IN THE BAKKEN SHALE

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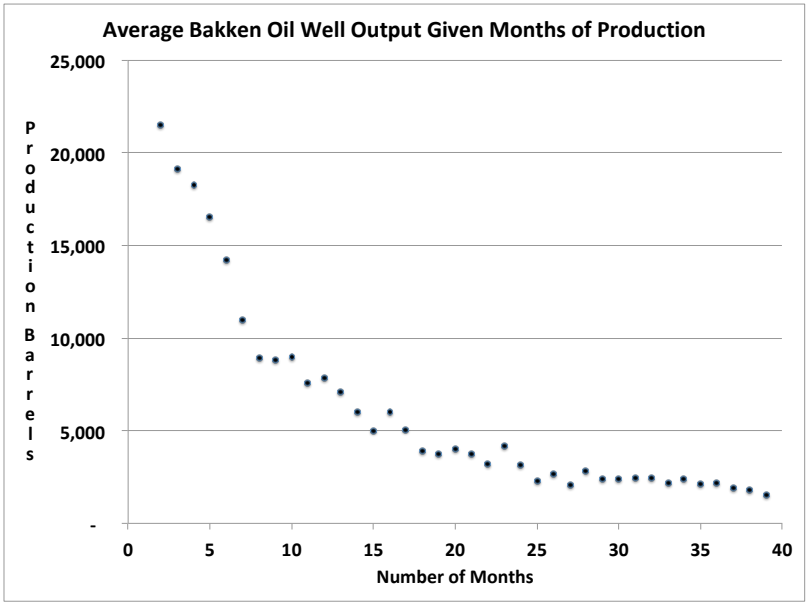
Overview

For decades the oil industry has applied a simple rule estimating a constant "decline" rate in conventional oil wells. Typically production in an oil field declines at an annual rate of around 8% to 10%, absent further investment. This allows field production to be counted on for two decades or more. Shale oil development, however, has turned the rule of thumb on its head, with decline rates as much as 50% in the first year. In order to maintain oil shale production the industry must constantly drill new wells. This has led many analysts to reason that shale oil has become a balance wheel for the world oil market: low oil prices reduce the incentive to drill and within a few months reduced supply restores higher prices. Since 2014 this has been the observed paradigm, with shale oil waxing and waning as the market changed.

Review of North Dakota Bakken shale oil wells, however, reveals a more complex story than that initially imagined. As noted, shale oil production declines rapidly in the first year, but the rate of decline appears to taper off after the first few months. Moreover, there is extraordinary variation in each well's production pattern. Some wells produce for only a few months with output dropping fast, others act more like conventional production. Below is a graph of the average well production of Bakken Shale.



We estimate the form and parameters of decline rates from well-level data in the Bakken Shale. An issue regarding the impact of the "shale revolution" is the speed of decline and the expected life of shale oil wells. The faster shale plays are depleted, the shorter will be the industry's price cycles.

Methods

Data cover 12,832 wells in the Bakken pool over 42 months beginning in May of 2015. We use standard techniques of regression for panel data. We test the hypothesis of a constant reduction in the rate of decline in the context of a hyperbolic model of decline. We also compare the hyperbolic model to a model using a constant rate of decline.

Results

We find that the hyperbolic model fits the data far better than the model using a constant rate of decline. The hypothesis that the reduction in the decline rate in the hyperbolic model is constant is rejected statistically, but the change in the monthly decline rate may be small.

Conclusions

The Bakken data confirm that shale plays experience rapid rates of decline in that the hyperbolic curve fits them much better than a constant rate of decline. The implication is that the shale revolution may not extend too far into the future, unless drilling continues.

References

Lund, L. (2014). Decline Curve Analysis of Shale Oil Production - The Case of Eagle Ford, masters thesis in energy systems engineering, Uppsala Universitet.