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Rigging economics

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Abstract: Rigging economics Advances in horizontal drilling have significantly increased US oil and gas production, but it is not clear whether the industry is viable if oil prices continue to be low. Researchers now estimate the break-even price for oil and gas from tight formations and analyse the factors that affect investment in drilling rig.

In 2014, crude oil prices experienced their largest drop since the 1980s: within only six months, the price for Brent crude oil fell by US\$69 per barrel, one year later even bottoming at a price of US\$28. Two main forces were central to this development. The first was the ‘shale oil revolution’: the vast expansion in the US production of tight oil (commonly mislabelled as shale oil). The second was the Organization of the Petroleum Exporting Countries (OPEC), whose unexpected response to the US competition was to not curb production. Writing in *Nature Energy*¹, Esmail Ansari and Robert K. Kaufmann provide unique econometric insight into the dynamics of the tight oil and gas industry and the price crash. Using time series analysis, Ansari and Kaufmann estimate the effect that prices and technological progress have had on the production of tight oil as well as its feedback on oil prices. Their study explains why OPEC’s future decisions might be more constrained, and why tight oil production was able to regain market shares in 2016 despite low prices.

Given the unprecedented speed of innovation in the renewable energy sector, incumbents may actually have every incentive to modernize the industry. Along with shifting demand patterns and geopolitics, technological progress has changed the nature of the oil sector and players both established and emerging have to keep step². The new market refuses to adhere to old dictums such as the misconception that the price of oil would necessarily increase over time. This was motivated by the principle that an exhaustible resource exhibits a convex increasing path (the Hotelling rule), and the belief that oil will exhaust in the years to come (peak oil). The first, an economic theorem summarized by a handy differential equation, has long been a central component of many models, despite the repeated empirical rejection of its actual impact on market dynamics^{3,4}. As far as peak-oil theory is concerned, proven oil reserves have actually increased over recent years instead of declining. This means that running out of oil is not a problem; the problem is that we have too much oil and some of it needs to be left in the ground to meet climate targets^{5,6}. US shale has been one of the key contributors to this increase in reserves.

At the core of the study of Ansari and Kaufmann is this shifting dynamic on the supply side, the emergence of the US tight oil industry as a major producer and OPEC’s incapability—or indisposition⁷—to balance the market. Tight oil (gas) refers to conventional oil (gas) that is produced from low-permeability rock formations using unconventional techniques, most popularly hydraulic fracking. With an increase of 3.6 million barrels per day within less than four years, tight oil contributed to an almost twofold increase of US crude oil production between mid-2011 and late 2014. Despite prices dropping by US\$30 in mid-2014, the 166th OPEC meeting on 27 November 2014 concluded with the decision not to curb production. The exact grounds for this decision remain unclear⁸, but a loose consensus could be formulated that the reason was a desire to hit the US tight oil industry, assuming

that it would buckle under price pressure⁷ given the uncertainty about the industry's potential⁹. Late 2016, however, saw OPEC strike a major deal on freezing production levels, inverting the previous strategy.

Research² mentioned early that the tight oil industry differs substantially from conventional oil, especially with shorter project horizons and higher leverage. Besides that, insights into the industry — especially production costs — have been rare and mostly of anecdotal nature. This is because accurate estimates about the lifetime productivity of horizontal wells do not exist to date. Especially before 2015, analysts often echoed a break-even price (that is, the price of a barrel below which production is not profitable) between US\$60 and 80; therefore, a continuation of tight oil production in 2015 and an expansion from 2016 onwards (despite prices between US\$44 and 53 per barrel) has confounded observers⁸.

First answers to this conundrum came from a bottom-up analysis of tight oil dynamics. Kleinberg and colleagues¹⁰ highlighted that the perception of a supply curve as the unique mapping between price and quantity does not match tight oil reality. There is no single break-even price, rather the sequential fashion of decision-making between initiating a project, drilling a well and extracting oil leads to at least three different but relevant concepts of break-even — each of which depends on the timing and direction of the price change.

Ansari and Kaufmann finally add the missing piece of the puzzle through their empirical top-down analysis of the events. They were able to estimate a tight oil break-even of US\$50 per barrel (covering production and development without infrastructure) by developing several models for the number of rigs from 2007 to 2017 and their efficiency (barrels produced per rig) and identifying the most accurate one. The oil price was the independent variable. They show that price volatility is a central variable particularly crucial around the break-even. Once prices withdraw from that level, volatility becomes less relevant. This explains why (some) drilling did not even stop at low prices. Moreover, the researchers were also able to prove that the apparent decoupling between market prices and tight oil production from 2016 onwards can be connected to productivity increases.

Where does this leave the crude oil market? The estimated dynamics between tight oil, market price and technology reveal that OPEC's future decision space may be restricted. As Ansari and Kaufmann note, although shale oil cannot be a marginal producer, it is able to balance the market in the mid-run. Squeezing the market, as in 2014, will not work. This means that OPEC's already disputed identity as a cartel^{8,11} may become even more complicated and intangible. However, non-supply dynamics emerge as the major uncertainty. Between global population growth, climate change mitigation efforts and new technologies, the demand side may actually set the future course.

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