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OPEC, Saudi Arabia, and the shale revolution: Insights from equilibrium modelling and oil politics

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ABSTRACT

Why did OPEC not cut oil production in the wake of 2014's price fall? This study aims at aiding the mostly qualitative discussion with quantitative evidence from computing quarterly partial market equilibria Q4 2011 – Q4 2015 under present short-term profit maximisation and different competition setups. Although the model performs reasonably well in explaining pre-2014 prices, all setups fail to capture low prices, which fall even beyond perfect competition outcomes. This result is robust with respect to large variations in cost parameters. Rejecting present short-term profit maximisation, as well as a qualitative discussion of Saudi Arabian politics and the shale oil revolution, lead to the conclusion that the price drop of 2014-16 was most plausibly the result of an attempt to defend market shares and to test for shale oil resilience, besides being fuelled by other factors such as rising competitiveness of alternative technologies. Although shale oil might have increased competition permanently (as supported by model results), the agreement of December 2016 should not be misunderstood as an OPEC defeat.

1. Introduction

The 2014–2016 drop in crude oil prices has been researched extensively by oil market analysts. Although results have given evidence for a variety of drivers, including decreased demand and geopolitical circumstances, the *shale oil revolution* is widely considered to be the main driver of price developments. Since 2012, crude oil production capacities in the US have nearly doubled due to the rapid growth of its shale oil industry. The term 'shale' refers (imprecisely) to conventional oil trapped in low-permeability formations and extracted by unconventional methods such as hydraulic fracking and horizontal drilling.

Why OPEC did not respond to the expanding shale production and falling prices with production cuts remains an open question. Other researchers' results in these regards fall into three main categories: (1) OPEC tried to defend its market share by flooding the market in an attempt to drive out shale producers; (2) the shale oil revolution nullified OPEC's market power, leaving its members no choice but to accept low prices; and (3) OPEC was uncertain about the potential of shale oil and needed to test its performance under low prices (Background section).

However, most discussion of OPEC's intensions are purely qualitative, with little or no quantitative evidence. This paper aims to bridge this gap with insights from computational equilibrium modelling. Specifically, I construct a model of the global crude oil market from 2011 Q4 through 2015 Q4 and compute market outcomes numerically under different competition setups for each quarter (Model section). The model, which is in an extension of the framework proposed by Huppmann (2013), does not aim to provide a comprehensive picture of the crude oil market, but rather an understanding of whether prices pre- and post-drop can be explained within one common framework of *business-as-usual* competition. Subsequently, I embed the results in an extended discussion about the nature of shale oil and oil politics; especially the different strategic and economic factors that might influence Saudi Arabia.

The inability of short-term profit maximisation to explain low prices (despite a reasonable model fit until late 2014) allows me to reject the claim that developments are the sole outcome of changes in market fundamentals and static competition (Results section). This is robust with respect to changes in the cost parameters, such that (a possibly not

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captured) increased efficiency of shale producers over time is unlikely to change this result. In the context of actual events and the deferred decision to cut production in 2016, I conclude that initial OPEC policy aimed at defending market shares against shale oil and at evaluating the elasticity of shale supply (Discussion section). The latter turned out to be more robust and resilient than expected, besides fiscal pressure from the burden of low prices on oil-dependent OPEC economies. Further developments, such as increasing pressure from climate change policies, might have strengthened incentives to flood the market, along with national politics. Saudi-Arabian-led efforts to negotiate a deal, ultimately reached in December 2016, should not (necessarily) be interpreted as the abandoning of previous strategies or as an OPEC defeat, even though the shale revolution may have permanently altered the market structure, with prices unlikely to return to pre-2014 values. This is supported by a counterfactual model setup in which OPEC acts as a single entity without regard to the profit distribution among its members, revealing high prices might require a coordination on high production cuts that is politically infeasible.

As mentioned, despite a large literature discussing the issue, including, for example, Baffes et al. (2015), Baumeister and Kilian (2016), Dale (2016), Fattouh et al. (2016), Khan (2017), and Aguilera and Radetzki (2015), the only study featuring a comprehensive formal discussion and a numerical calibration is Behar and Ritz (2017). However, their quantitative part is limited to predicting the strategic decision between defending market share and maximising short-term profit.

2. Background

2.1. The falling price puzzle

After the steep rise in 2008, oil prices remained on a high level until late 2014, when prices started falling. Fig. 1 depicts the price trajectory from 2011 to 2015, which is the period relevant for this study. Quarterly prices fluctuate around an average of approximately 100 USD / bbl between 2011Q4 and 2014Q2. WTI Crude reached its peak quarterly in early 2012 with prices exceeding 110 USD / bbl. A quarter later it fell to 80 USD / bbl; the lowest price in that era. Henceforth, I refer to this period as the “first part” or the “high-price period” in contrast to the “second part” or “low-price period”: Between 2014 Q3 and 2015 Q1, quarterly prices dropped by more than 50%. Most of this fall took place during late 2014 and ended with a quarterly average barely above 40 USD / bbl in 2015 Q1. Subsequently, oil prices recovered slightly before falling in 2015 Q3 even below.

Another development taking place concurrently is the rapid expansion of shale oil, as shown on the right-hand side of Fig. 1. The United States is home to most known shale oil reserves, although countries like Australia, Brazil, Canada, and Russia are potentially endowed as well. The *shale oil revolution* is a main driver for the price-drop: its quick expansion led to an excess supply of crude oil that, in turn, put downward pressure on prices. This is what basic microeconomics suggests. However, as Fig. 1 depicts, the expansion of US capacities was an almost smooth development over the years. Prices, in turn, exhibit an almost ad-hoc collapse such that identifying shale oil as the sole factor of the developments is economically implausible: It would require prices to react sudden and with a lag of multiple years. Baumeister and Kilian (2016) emphasise, based on an econometric analysis, that the price drop is a composite effect of positive supply shocks, negative demand shocks, and a shock in price expectations; however, they see demand changes as the main driver behind the price fall, with unexpected supply increases only influencing prices prior to 2014.

Additionally, a number of other influential factors are identified in the literature. Ambiguous results have been found regarding the influence of financial speculation: While Husain et al. (2015) reject this factor specifically, Fantazzini (2016) finds evidence for the presence of a negative financial bubble. The appreciation of the US-Dollar might have been another factor (Tokic, 2015); although some studies (Alquist et al., 2013; Coudert and Mignon, 2016) fail to confirm significance or report ambiguities with respect to the direction of the currency effect over time.

Dale (2016) describes the establishment of what he calls the *new economics of oil*. He links the developments to fundamental changes in oil market rules: Crude oil has become virtually non-exhaustible (and is priced as such) due to changed market conditions (tight climate policies, extensive discoveries of new oil fields, maturity of renewable technologies); the direction of global crude flows has changed eastwards, which leads to market lags, partially because of a rigid downstream industry; the global crude supply curve has become flatter due to quickly reacting shale oil; and – even historically – OPEC has only been able to counter temporary shocks, never structural ones.

The political risks of OPEC states has a strong positive effect on

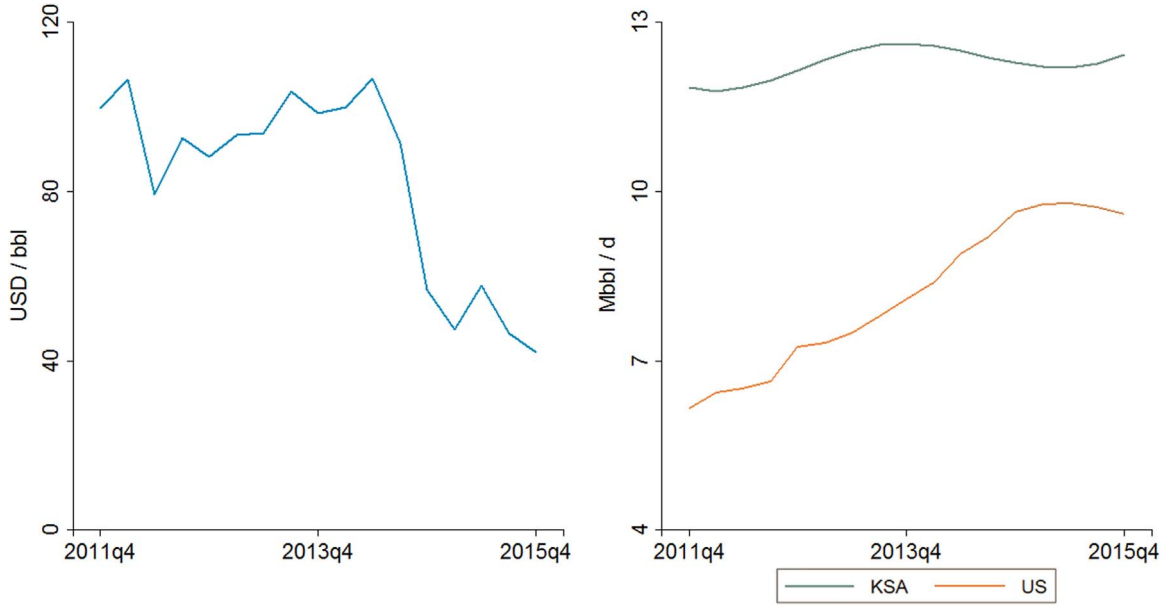

Fig. 1. WTI crude oil price (left) and estimated production capacities of Saudi Arabia (KSA) and the US (right). Data: IEA, Reuters, own calculations.