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What about the OPEC Cartel?

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The recent decision by the Organization of the Petroleum Exporting Countries (OPEC) not to decrease their output quota in spite of a drastic decline of crude oil prices has brought renewed attention to this supplier group dominating the crude oil market. However, the empirical evidence that OPEC truly acts as a textbook cartel is rather limited. This Roundup summarizes the theories proposed over the past decades to explain the fundamental structure of the crude oil market and the role of OPEC and Saudi Arabia, the pivotal supplier. The consensus in the academic literature points towards the interpretation that the group is acting as a non-cooperative oligopoly. We relate the theories to alternative interpretations of the price drop over the autumn of 2014.

The crude oil price has fallen precipitously in the second half of 2014. This development took markets by surprise; consumers, producers and other players had become accustomed to a world of “100-dollar oil”. The tumultuous period of 2008 was already in the distant past; for more than three years, global prices had remained relatively stable at the three-digit level. If anything, prices were expected to spike upwards again, due to the continuing sanctions against Iran, intensification of the conflict between Russia and the European Union over Ukraine, or further upheaval in North Africa. Yet within a few months in the autumn of 2014, the West Texas Intermediate (WTI) benchmark for light, sweet crude oil delivered in Cushing, Oklahoma, dropped from the stable plateau to only 73 US dollars per barrel (USD/bbl) on November 26, 2014, the day before the Organization of the Petroleum Exporting Countries (OPEC) was scheduled to convene for the 166th Ministerial Conference in Vienna, Austria.

In spite of the price decline by more than 30%, the OPEC oil ministers decided not to react with a reduction in output ([OPEC, 2014](#)). The next day, the WTI price had dropped further, to less than 66 USD/bbl. Only in late January 2015 have oil prices stopped their descent at a level below 45 USD/bbl, before jumping back up. The WTI price currently stands at roughly 50 USD/bbl. The price development since the turn of the century for WTI and the Brent basket, the major European price index, is illustrated in Figure 1.



Figure 1: Daily crude oil price, West Texas Intermediate (WTI) and Brent, in nominal USD/bbl; the OPEC meeting on Nov 27, 2014, is marked for illustration (source: EIA, http://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm, accessed February 26, 2015)

The cartel that isn't

The decision by OPEC not to curtail production and thereby stabilize markets brought renewed attention to the supplier group which collectively produced more than 40% of global crude oil supply in 2013 and holds more than 70% of proved reserves (BP, 2014). A brief recap of OPEC's history: it was founded in 1960, amidst a wake of nationalization of crude oil production assets formerly controlled by multinational oil companies (Yergin, 1991). Alas, it did not gain notoriety until the 1973 oil embargo in retaliation for the Yom Kippur war, which saw prices increase fourfold within a few months. The next important episode was in the following decade when Saudi Arabia attempted to reign in over-production of other OPEC members, first by reducing its own output and, when that proved unsuccessful to stabilize prices, by aggressively expanding its sales, leading to an even more drastic reduction of prices. In game-theoretic terms, this is called a "tit-for-tat" strategy: if one player cheats in order to boost its short-term profits, it is punished by all other players who also deviate from the collusive strategy, leading to an erosion of future profits.

Even though OPEC is sometimes used as a textbook example of a cartel, there is no clear-cut consensus in the academic community whether OPEC is indeed acting as a cartel, or rather competitively or as a non-cooperative oligopoly. On its website, the organization states its mission to "coordinate and unify the petroleum policies of its Member Countries and ensure the stabilization of oil markets [...] and a fair return on capital" (http://www.opec.org/opec_web/en/about_us/23.htm, accessed February 15, 2015). This sounds very much like the objective of a standard cartel, namely maximizing joint profits; however, unlike a standard cartel, OPEC does not have mechanisms for internal compensation and effective enforcement to align the incentives of its members.

OPEC uses a quota system in which each member is assigned a quantity that it is allowed to produce over the following months. The share of production is determined by the stated reserves. This creates incentives for each OPEC member to overstate its reserves to gain a larger share of the quota. Furthermore, oil production is difficult to keep track of, so cheating and over-producing the assigned quota is common and usually tolerated by the group (Dibooglu & AlGudhea, 2007).

Wirl (2012) provides an overview of the economic and political objectives of OPEC members, briefly recapped below; using a stylized "back-of-the-envelope" calculation, he concludes that the cartel hypothesis is the most likely explanation for

observed OPEC behaviour. In contrast, we developed a spatial partial-equilibrium model of the global crude oil market and tested different hypotheses of OPEC behaviour (Huppmann & Holz, 2012). We found that a cartel would have resulted in far higher crude oil prices over the period 2005-2009 than actually observed and that a non-cooperative oligopoly with Saudi Arabian leadership in a Stackelberg leader-follower model yields results closer to actual market trends.

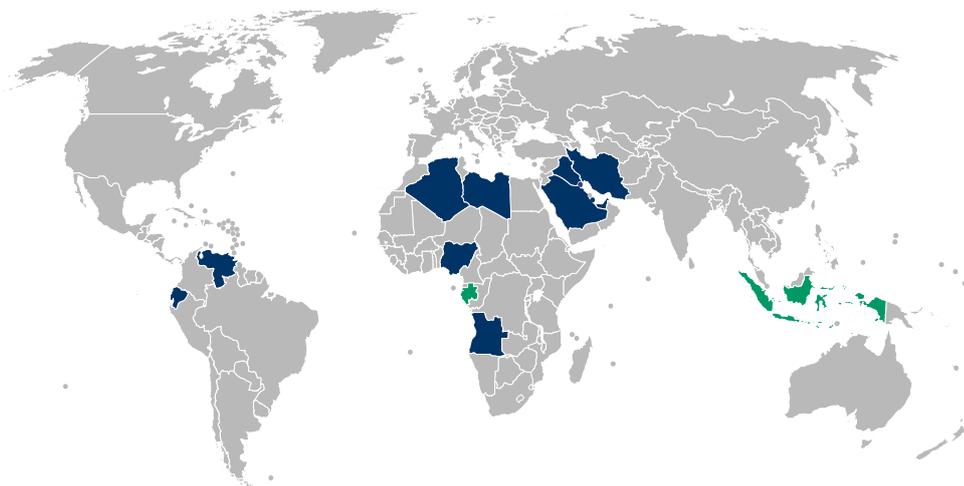


Figure 2: OPEC members (blue, as of February 2015), former members (green)

When looking at individual OPEC members, it quickly becomes clear that the organization forms a very heterogeneous group: Saudi Arabia has ample financial reserves and a reserve-to-production (R/P) ratio of its oil sector of 63 years (BP, 2014), meaning it could continue to produce at current levels for 63 years without additional discoveries or significant improvements in technology. In contrast, Algeria and Angola only have R/P ratios of twenty years; their interests are therefore rather focused on the short-term. At the same time, as developing countries, they may only be able to re-invest a certain level of revenues domestically without triggering “Dutch disease”-style distortions of their terms of trade. Hence, these countries are likely aiming at generating a certain income level rather than maximize profits. They may therefore reduce output in times of rising oil prices, but increase output as a response to falling prices to meet a certain income target, a behaviour called the “target revenue” model (Alhajji & Huettner, 2000).

At the other end of the spectrum of OPEC members are Iran and Venezuela; they have ample crude oil reserves, but the governments are highly dependent on oil revenues to finance the national budget. In these countries, political interference in government-owned oil companies triggers a bias towards short-term revenue maximization to please political constituencies. Furthermore, these countries may see crude oil as a “weapon” against perceived threats from Western countries; political motives of oil decisions cannot be neglected, which was evident many times over the past half century.

The long-term dynamics of the crude oil market

When supplying a finite resource, economic theory postulates that its price must rise in lockstep with the rate of interest due to the consideration of inter-temporal arbitrage; otherwise, a supplier would either extract more oil today and invest in financial assets, or postpone production until prices rise in the future. This is known as the “Hotelling rule”, named after the author of the seminal paper (Hotelling, 1931).

Alas, the crude oil price fails to exhibit an exponential price increase over the long term (Figure 1). Hart and Spiro (2011) and Livernois (2009) review various extensions of the Hotelling rule to rationalize this phenomenon: these include technological progress, a backstop technology such as renewable energy sources, increasing costs relative to remaining reserves, and uncertainty.

In a more recent contribution, Spiro (2014) argues that oil suppliers may act optimally given that they have bounded rationality: rather than optimizing over the entire time horizon until all reserves are depleted, they only consider the medium-term outlook. According to Spiro's analysis, the considered time frame is roughly the next four decades. When remaining reserves are perceived to be insufficient over this horizon, prices increase according to the Hotelling rule; otherwise, prices remain relatively flat. His analysis can explain most price spike over the past decades, except for the crude oil market turmoil in the eighties – which arguably was a political event, rather than driven by fundamentals.

Another aspect in the long-term dynamics of crude is the question of peak oil and the Hubbert curve, a term named after the geologist M.K. Hubbert (1962). He observed that oil production from any field follows a bell-shaped curve: slow start, high peak, then decreasing production until the field is depleted. The tailing-off of production is mostly due to geological and engineering issues such as a reduction of reservoir pressure. This logic is sometimes applied to the aggregate crude oil production (EWG, 2008). However, the experience of the last years has shown that this may be a fallacy: for example, just recently, the ultra-deep offshore discoveries in Brazil or the US shale oil boom were evidence that peaks of global crude oil production are difficult to forecast. As long as the willingness-to-pay by consumers (in other words, the price) is sufficiently high, crude oil will be plentiful for many years to come (IEA, 2013).

In spite of sufficient supply, long-term aspects of demand adaptation in the OECD countries must also be considered when discussing the market outlook and the behaviour of suppliers: while consumption is very inelastic in the short run, continuously high or volatile prices may trigger demand reduction measures or fuel substitution in industrialized importing countries, such as electric mobility or the switch from fuel oil to natural gas in heating. Such an adaptation of technologies and appliances may reduce consumption of oil in the long run. Hence, it is clearly in the interest of suppliers with substantial reserves to guarantee price stability, thereby mitigating the incentives for consumers to reduce their reliance on oil. It is for this reason that Saudi Arabia is often perceived to act as swing producer, withholding production capacity in order to maintain the ability to compensate short-term disruptions and shocks.

Understanding the dynamics of short-term fluctuations and the recent price drop

In the short term, from the perspective of fundamentals, the crude oil market is driven by available capacity given that demand is sluggish and investment in exploration and production capacity requires considerable lead-time. There is considerable debate in the media and in the academic community whether speculation has a persistent impact on crude oil prices. Disentangling the interdependencies between expectations of various actors in the market for “paper oil” and the fundamentals of supply and demand is a formidable challenge. Kaufmann and Ullman (2009) argue that speculation had at least an exacerbating effect during the price spike in 2008.

The major driver of the price increase in the run-up to the 2008 spike is generally attributed to growing demand from China and the start of a commodities super-cycle (e.g. Smith, 2009). Conversely, the recent price drop was most likely sparked by

lower-than-expected demand in conjunction with the strong expansion of production capacities in the shale oil boom in the US (cf. [IEA, 2015](#)). The strong growth in domestic oil production led to considerable distortions across the country, as the traditional supply-and-demand patterns for different types of crude were upended and major infrastructure bottlenecks emerged ([Kilian, 2014](#)); the WTI benchmark even diverged considerably from other global indices such as Brent due to insufficient transport capacity out of Oklahoma (Figure 1).

The Economist ([2014](#)) argues that the decision by OPEC in November 2014 not to reduce their quota was driven by the desire to drive shale oil producers out of the market; according to this interpretation, OPEC acted strategically, seeking to deter further investment in North American unconventional oil and defending its market share. Yet there is an alternative storyline: the ability of a dominant supplier to exert market power depends crucially on the responsiveness of the market (i.e., demand) and of the ability of rivals to compensate withholding of supply by the dominant suppliers. According to Huppmann ([2013](#)), the price spike in 2008 has been (at least) aggravated by the limited spare capacity of competitive fringe (i.e., non-OPEC) suppliers. The strong demand increase during the commodity boom allowed OPEC to drive prices higher without losing much market share, because rivals could not offset the withholding by OPEC in the short term.

The opposite may indeed have happened over the past months: shale oil has dramatically changed the marginal cost structure of crude oil production. Rather than having high investment expenditure and low lifting costs (as typical conventional oil production), shale oil production can be switched on and off at relatively low upfront costs, but it exhibits high marginal operational costs. Hence, any reduction in the OPEC quota in the fall/winter of 2014 would have been easily compensated by shale oil, in light of weak demand and abundant supply. Hence, a quota reduction may not have stabilized prices, but would just have led to a loss of OPEC market share. In other words, the refusal of OPEC to reduce production may have been a tacit admission that – in the current environment – its ability to stabilize prices and dominate the market is limited.

Between a barrel and a hard place

The price drop in the second half of 2014 was a “black swan” event. The shale oil boom and weak demand have taken markets by surprise; expectations of a stable plateau and an era of “100-dollar oil” were certainly shattered. Recent events can be seen as a validation of OPEC acting strategically as a dominant supplier group, purging high-cost producers from the fringe suppliers to strengthen its own position in the long run; or the past months can be interpreted as OPEC being overtaken by market developments beyond its control. Will shale oil investment decrease, because OPEC strategically drove US producers out of the market; or is the current trend just a broader market adjustment, which an OPEC quota reduction might have postponed but not averted? Empirically, these two storylines are virtually indistinguishable. From an academic point of view, deciding which of the two is a better and more plausible explanation is almost impossible.

Shale oil has the potential to change the dynamics of the crude oil markets for the foreseeable future because it upends the capital-intensive investment cost structure of the industry and reduces the lead-time of new production capacity. Alas, it remains to be seen whether the price drop has led to a significant and persistent reduction in crude oil investment activity, and to what extent it has impacted the ability of shale oil to react swiftly to future market developments. The outlook for crude oil, arguably the most important commodity in today’s economy, and the role of OPEC is as uncertain as it ever was.

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