Energy meet in June 2018. That OPEC/NOPEC should be very wary about unwinding the output cut agreement when they next to maintain the recent price gains, they have to extend their output cut until the end of 2018; releasing importance for the strong oil demand momentum experienced in 2017 to car prices well above our baseline or reference forecasts. The results also show the paramount price, with factor putting a ceiling on the oil price, while supply disruptions could provide some support to the oil supported at around $65/b. Our results show that for 2018, US shale output growth will be the key stronger than expected oil demand and the OPEC/NOPEC output cuts have tightened the oil market $75/b, with a 2018 average price of $67/b. The baseline forecast suggests that the momentum of for Brent to trade within a narrow price range, with a price floor at above $60/b and a ceiling at the time of the forecast or some other hypothetical events. Our reference forecast scenario projects but rather modelled projections of various oil OPEC at 60: The World With and Without OPEC Bassam Fattouh and Andreas Economou Oxford Institute for Energy Studies Oil Price Paths in 2018 Abstract The extent of supply disruptions amid a fragile geopolitical environment. The potential impact of higher oil prices on global oil demand; The Interplay between OPEC, US Shale The OPEC/NOPEC exit strategy from the output cut agreement reached in November 2016; e to the recent oil price rise; a sharp fall in Venezuelan output constituting the biggest geopolitical risk that could push above $70/b, expecting a lower path in the mid $60/b. The key uncertainties behind about how the oil price path could evolve in 2018, with some revising upwards their forecasts to still a wide uncertainty engulfing the oil market, few days and all the key international crude oil benchmarks flipping into backwardation. Yet, there is 2018 started on a positive note for oil markets with Brent prices breaking through $70 a barrel for a l price risks conditional on certain events that are known and Supply Interruptions: the world oil market using a structural model of the oil market and mics, the oil price will continue to be Andreas Economou, Research Associate, OIES
An historical perspective

We explore the historical contribution of OPEC for global oil market stability since 1990

- Analysis builds on a methodology simulating counterfactual outcomes in the rich context of state-of-the-art structural VAR models of the world oil market and concludes by employing a CGE model to determine the global welfare implications of OPEC’s spare capacity.

- Imagine a world with (actual) and without (counterfactual) OPEC, in which counterfactual scenario OPEC is producing at maximum capacity and hence, has held no spare capacity and no balancing role since 1990.

- We assess the importance of OPEC during its modern history and quantify its impact on the functioning of the global oil market in terms of the historical evolution of oil production, prices, volatility, supply-demand elasticities and global stocks, as well as on global welfare.

- Analysis concludes with the importance of the more recent historic Declaration of Cooperation between OPEC and non-OPEC producers for the rebalancing of the global oil market after the 2014/16 oil price collapse.
Methodology
The workhorse model of the World Oil Market

4-variable structural VAR

Counterfactual analysis builds on a four-variable structural VAR model in the tradition of Kilian and Murphy (2014)\(^1\) that decomposes the oil price to its components driven by flow supply, flow demand and speculative demand.

**Flow supply shock:** shocks to crude oil supply that arise from geopolitical episodes, the output decisions of oil producers and other supply shocks.

**Flow demand shocks:** shocks to the demand for immediate consumption associated with fluctuations in the global business cycle.

**Speculative demand shocks:** shocks to stock demand reflecting the forward looking behaviour of the market participants.

**Other demand shocks:** Other idiosyncratic shocks not captured by the preceding structural shocks.

In constructing the **counterfactual** we replace the estimates of the flow supply shock \(\varepsilon_t\) from 1992 to 2018 by counterfactual values reflecting the path of global oil production in the absence of OPEC spare capacity and follow Kilian (2016)\(^2\) in providing explicit estimates of the impact on monthly Brent price.

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Not all oil supply shocks are alike

5-variable structural VAR

Recently, Economou et al. (2017)\(^3\) refined the SVAR oil market model due to Kilian and Murphy (2014) to further decompose the supply components of the oil price to supply shocks that are explicitly associated with geopolitical disruptions (exogenous supply shocks) and those that arise from within the oil market by the output decisions of oil producers (endogenous supply shocks), along its demand-driven components.

This distinction is important because the impact of each distinct type of supply shock on oil prices differs greatly, both in terms of magnitude and duration.

Identification procedure

<table>
<thead>
<tr>
<th></th>
<th>Exogenous supply</th>
<th>Endogenous supply</th>
<th>Flow demand</th>
<th>Speculative demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPEC disruptions</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Global crude balance</td>
<td>+</td>
<td>–</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Real activity</td>
<td>–</td>
<td>+</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Oil price</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Inventories</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>+</td>
</tr>
</tbody>
</table>

Historical evolution of oil supply and demand elasticities

Time-varying parameter VAR

Having estimated the historical evolution of the oil price in the absence of OPEC’s spare capacity based on the counterfactual production path, we employ a Bayesian structural VAR oil market model with time-varying parameters (TVP-VAR) and stochastic volatility in the innovation process in the spirit of Baumeister & Peersman (2013)\(^4\).

This framework enables the assessment of the joint evolution of the short-run price elasticities of oil supply and demand at each point in time.

**Identification procedure**

\[
y_t = (\Delta prod_t, rea_t, \Delta ropo_t)^\prime
\]

<table>
<thead>
<tr>
<th>Percent-changes in global oil production</th>
<th>Real price of oil</th>
<th>Real economic activity index</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Flow supply</th>
<th>Flow demand</th>
<th>Other demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil production</td>
<td>−</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Real activity</td>
<td>−</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td>Oil price</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Supply elasticity bound</td>
<td>n/a</td>
<td>We remain relatively agnostic to the bounds of the oil supply and demand elasticities in the TVP-VAR, as the objective is to assess the extent to which the slope of the oil supply and demand curves have varied over time.</td>
<td></td>
</tr>
<tr>
<td>Demand elasticity bounds</td>
<td>n/a</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The GDP impacts are determined for two types of supply shocks in the CGE framework:

- OPEC produces at maximum capacity in the absence of exogenous supply shocks.
- Exogenous production shortfalls elsewhere under full capacity utilisation in OPEC countries.

The welfare impacts are obtained by combining the actual and counterfactual oil prices obtained by the SVAR, as well as the actual and counterfactual production paths, with the annual GDP response curves obtained by the results of the CGE sensitivity analyses.\(^5\)

### Crude oil production technology

\(^5\) With contribution of Victor Nechifor, Research Associate, UCL Institute for Sustainable Resources.
The world with and without OPEC: An historical perspective
Evolution of global oil production w/out OPEC

In a world w/out OPEC, crude oil production would have averaged higher by 2.5 mb/d, with most of the difference attributed to KSA. The growth of global production however would have been slower by 1.5 mb/d (1990-2018).

The volatility of global oil production would have averaged less than 0.8%, compared to the actual 1%, due to the absence of OPEC’s output adjustments in response to oil supply and demand shocks hitting the market.

Source: OIES
Oil supply shocks in the absence of spare capacity

Sequence of oil supply shocks

- Despite the decline in global oil production volatility, oil supply shocks would have been significantly larger and more persistent, as w/out spare capacity there would be no buffer against abrupt supply disruptions.

OPEC geopolitical supply disruptions

- Overall, geopolitical supply disruptions would have averaged 0.8 mb/d higher and during key episodes they would have been twice as large as the actual observed (e.g. 1990, 2002/03, 2011-onwards).

Source: OIES
During episodes of tight markets, the Brent price would have spiked higher in the absence of OPEC’s spare capacity (e.g. 2005/07); while during episodes of weak markets, prices would have persisted lower for longer (e.g. 2009/10).

The presence of spare capacity has had a smoothing effect on global oil price movements, with prices in the absence of the spare capacity cushion exhibiting much sharper price cycles and resulting in more frequent oil shocks.

Source: OIES
Implications for oil price volatility

Oil prices in a world w/out OPEC spare capacity would have been more volatile, as the price adjustments and readjustments to the prevailing market conditions would have been larger and more frequent.

On annual terms, the price volatility would have been almost twice as large as the actual, affecting adversely the economic interests of producers (e.g. investment inefficiencies) and consumers (e.g. dampening growth prospects).

Source: OIES
Implications for the joint evolution of oil supply and demand elasticities

- With OPEC producing at maximum capacity, the supply and demand elasticities would have been markedly lower and only half the actual observed. On average, the short-run elasticity of supply would have declined to 0.06 from 0.1.

- Oil demand would have become less elastic averaging at -0.8, as opposed to the actual -1.3, because the share of precautionary demand for oil on total demand would have been higher leading to a steeper oil demand curve.

Source: OIES
In the absence of spare capacity in 2011, the Brent price would have been higher by $46/b, with the entire difference attributed to the larger impact of oil supply shocks, pushing prices to uncharted territory in 2012/13, close to $165/b.

In the H2 2014, the Brent price would have plunged even further by $22/b, as all three supply-demand shocks would have generated a larger negative price response. That is despite OPEC choosing to defend its market share.

Source: OIES
Price responsiveness to oil supply shocks

No spare capacity, no buffers

In the event of a hypothetical geopolitical supply disruption in oil supplies of 1 mb/d, the price response in the absence of spare capacity will be twice as large (actual case peaks at $6/b vs counterfactual case that peaks at $10.4/b).

But not only is the price increase expected to be larger, but also the price episode is expected to be longer in duration. That is because in the absence of spare capacity, the production shortfalls associated with some geopolitical episodes cannot be replaced by other producers, nor can stocks mitigate the impact of the supply shock on price until the latter have fully adjusted to the episode in question.

Essentially, in the absence of OPEC spare capacity the market has no mechanism to act as a buffer against abrupt oil disruptions, leaving it to prices to clear the market via large unexpected adjustments.

Source: OIES
Price responsiveness to oil demand shocks

- By suppressing prices lower, spare capacity has the effect of maintaining the momentum in growth. In contrast, in the absence of spare capacity, the higher oil price acts to dampen the prospects of global growth.

- If OPEC abandons its balancing role in a falling market characterised by a slowdown in global oil demand amid increasing oil supplies, the price response is expected to be sharper, more persistent and steeper.

Source: OIES
Implications for global oil stocks

Total stock changes

In the absence of OPEC’s *below-ground* inventories, global stocks (i.e. *above-ground*) would have averaged 3.7 mb/d higher, as the stock-out avoidance (or precautionary demand) motive becomes more prominent.

Changes from actual world

Two important issues arise. First is the issue of the cost of holding more stocks above-ground and who bears that cost. Second, higher stocks would have had few stabilising effects, because stock withdraws would have been very rigid.
Overall, OPEC market share would have been higher over the entire period by 2.1%, relative to the actual observed, averaging 43.7% of the total compared to 41.6%.

KSA would have experienced a slightly higher gain in market share relative to other OPEC oil producers by 2.6%, averaging 15% throughout, mainly due to its large low-cost oil reserve base.
Impact on World GDP

- Shifts in OPEC output policy and abandoning its balancing role have global welfare implications that are channeled through the price outcomes. The impact however is different across regions and varies across time.

- A production increase leading to a 25% price decline would have boosted GDP by 0.15% in 2004/07 and 0.20% in 2011. The differences over time are higher when factoring in the global GDP expansion between 2004/11, leading to gains of $50B, $75B and $150B.

Source: OIES
In the face of supply disruptions however, the net negative impact on global GDP is much higher and more-than-offsets the expected gains. Again the impact increases over time as a marker of a decreasing oil demand elasticity.

In absolute terms, for a 27% price increase induced by a negative supply shock in the absence of spare capacity, the cost of the supply shortfalls on global GDP rises from $60B in 2004, to $80B in 2007 and $185B in 2011.

Source: OIES
Global welfare implications

The cost of lack of spare capacity

An oil price decrease driven by OPEC producers maximising their output, ceteris paribus, leads to a net GDP increase for the oil-importing countries. At the same time, lower prices determine a loss in oil revenues for oil exporters and as such have a negative impact on their respective GDP.

In tighter supply conditions, the impact on GDP in the absence of spare capacity is much higher. While oil exporters benefit from higher oil prices, the welfare impacts on oil importing countries is much larger.

The cost of lack of spare capacity grows significantly after 2012 with the net global welfare loss values in the order of $250-450 billion and by 2017 it is estimated at $360 billion.

These results underscore the growing welfare importance of spare capacity and OPEC in the oil market over time to smooth out unexpected and abrupt oil shocks.

Source: OIES
In December 2016, OPEC and non-OPEC producers formed the historic Declaration of Cooperation that helped accelerate the price recovery in 2017/18. The OPEC+ output cut deal, added up to $15/b to the price rebound.

OPEC+ also made a materially important contribution to the market rebalancing by accelerating stocks clearing by at least half a year and showed that it can overcome the many challenges facing producer-producer relations in a cooperative framework.
Energy Insight: 28

Bassam Fattouh, Director, OIES &
Andreas Economou, Research Associate, OIES

Oil Price Paths in 2018:
The Interplay between OPEC, US Shale and Supply Interruptions

Abstract

2018 started on a positive note for oil markets with Brent prices breaking through $70 a barrel for a few days and all the key international crude oil benchmarks flipping into backwardation. Yet, there is still a wide uncertainty engulfing the oil market, with very divergent views among market observers about how the oil price path could evolve in 2018, with some revising upwards their forecasts to higher than $80/b while others are less convinced that the market fundamentals can sustainably support a price above $70/b, expecting a lower path in the mid $60/b. The key uncertainties behind these divergent views mainly pertain to different views about:

- The OPEC/NOPEC exit strategy from the output cut agreement reached in November 2016;
- US shale supply response to the recent oil price rise;
- The potential impact of higher oil prices on global oil demand;
- The extent of supply disruptions amid a fragile geopolitical environment.

In this Energy Insight, we analyse how the oil price path could evolve in 2018 by evaluating the aforementioned risks underlying the world oil market using a structural model of the oil market and considering various forecast scenarios. Forecast scenarios are not predictions of what will happen, but rather modelled projections of various oil price risks conditional on certain events that are known at the time of the forecast or some other hypothetical events. Our reference forecast scenario projects for Brent to trade within a narrow price range, with a price floor at above $60/b and a ceiling of below $75/b, with a 2018 average price of $67/b. The baseline forecast suggests that the momentum of stronger than expected oil demand and the OPEC/NOPEC output cuts have tightened the oil market in 2017 and even with no change in current market dynamics, the oil price will continue to be supported at around $65/b. Our results show that for 2018, US shale output growth will be the key factor putting a ceiling on the oil price, while supply disruptions could provide some support to the oil price, with a sharp fall in Venezuelan output constituting the biggest geopolitical risk that could push prices well above our baseline or reference forecasts. The results also show the paramount importance for the strong oil demand momentum experienced in 2017 to carry on into 2018 for rebalancing the market and supporting the oil price. Finally, our results show that for OPEC/NOPEC to maintain the recent price gains, they have to extend their output cut until the end of 2018; releasing the withheld barrels under the current agreement would result in a sharp fall in oil prices, suggesting that OPEC/NOPEC should be very wary about unwinding the output cut agreement when they next meet in June 2018.