THE OXFORD INSTITUTE FOR ENERGY STUDIES

January 2017

Oil Price Paths in 2017:

Is a Sustained Recovery of the Oil Price Looming?

Summary

This paper explores how the oil price path could evolve in 2017 by assessing the various oil price risks under alternative forecast scenarios pertaining to future market conditions. It is shown that even without the OPEC-non-OPEC output cut agreement in November 2016, the three-year long price fall would eventually have come to a halt and stabilized at close to $41/b in 2017 based solely on market forces. The agreement, however, helped accelerate the price recovery by stabilising the oil price near $50/b. That said, the current price at above $50/b already incorporates the bulk of the expected gains from the full enforcement of the production cuts and reflects the positive shift of market sentiment that has been building-up in anticipation of the implementation of the output cut agreement. Thus, for the next year, the oil price path is more sensitive to downside risks depending on the discipline of OPEC and non-OPEC oil producers. In fact, for the price recovery to be sustained in 2017, OPEC efforts must be met by favourable market conditions in the form of an unexpected surge in global oil demand amid a moderate expansion of US shale supply. On the contrary, a deterioration of global economic activity, or an aggressive expansion of US shale supply, or both, could reverse the current momentum. Moreover, a return of oil production from conflict inflicted countries Libya and Nigeria could undermine the OPEC agreement from within. Eventually, whatever scenario plays out, OPEC will continue to assess the market conditions and in the second half of 2017, it can decide on whether to extend the agreement to offset any losses to the anticipated oil price recovery that may arise from changes in oil market conditions or to drop the agreement all together. But regardless which way the decision goes, the latest output cut agreement is critical to resolving fundamental uncertainties about the shock hitting the oil market and OPEC behaviour in a more uncertain world.

Andreas Economou, Bassam Fattouh,
Paolo Agnolucci and Vincenzo De Lipsis*

1. Introduction

In 2016, the Brent price averaged $43/b, representing a cumulative drop of 57% from the 2014 annual average of $100/b. In retrospect, however, 2016 is thought to have been a 'turning point' for the oil price collapse. The supply-demand imbalance tightened below 1.0 mb/d for the first time since February 2014, largely caused by a year-on-year (y-o-y) decline in non-OPEC crude oil production of 1.2 mb/d, of which the US shale production accounted for 0.58 mb/d. Unexpected disruptions in crude oil supply originating mainly from Libya, Nigeria and Venezuela amounted to 0.44 mb/d, while global oil demand recorded a robust annual growth of around 1.4 mb/d in 2016. The most supportive factor for oil prices in 2016, however, has been the agreement between OPEC oil producers to curb output by 1.2 mb/d as of January 2017, while securing an additional reduction of 0.56 mb/d from non-OPEC.[1] The output cut agreement marked a shift in policy from a two-year deadlock, which saw most countries produce at maximum capacity and Saudi Arabia showing unwillingness to balance the market without a collective agreement with other key producers.[2]

Yet, as the oil market heads into 2017 much of this optimism is overshadowed by the looming uncertainty pertaining to:

- OPEC and non-OPEC oil producers' compliance to the output cut agreement;
- The extent of the US shale supply response to higher oil prices;
- The sustained recovery of global economic activity;
- Any unexpected supply disruptions amid a volatile geopolitical environment.

In this paper, we discuss how the oil price path could evolve in 2017 based on forecast scenarios of the real price of oil that rely on a recently proposed structural model[3] of the global oil market in the tradition of Kilian and Murphy (2014) [4]. Forecast scenarios are not predictions of what will happen, but rather modelled projections of the various oil price risks in the year to come conditional on certain events that are known at the time of the forecast or some other hypothetical events.[5] In particular, such conditional forecasts allow us to explore how much the oil price forecast would change relative to the unconditional baseline forecast obtained by the structural model. The model distinguishes between:

- Unexpected disruptions in oil production that are caused explicitly by geopolitical events (*exogenous supply shocks*);
- Unexpected shifts in available operable capacity that are explicitly associated to market-specific events (*endogenous supply shocks*);
- Unexpected changes in oil demand that are associated with fluctuations in the global business cycle (*flow demand shocks*);
- Unexpected shocks to stock demand driven by the forward looking behaviour of the market participants (*speculative demand shocks*);
- Other oil demand shocks that are driven by a myriad of reasons that cannot be classified as one of the preceding structural shocks (*other demand shocks*).

[1] OPEC, 'OPEC and non-OPEC Ministerial Meeting', Press Release, 10 December 2016. http://www.opec.org/opec_web/en/press_room/3944.htm

[2] See Fattouh, B. and Sen, A. (2016), 'OPEC Deal or No Deal? This Is Not the Question', OIES Energy Comment, October; Fattouh, B. (2017), 'The Phases of Saudi Oil Policy: What Next?', Presentation made at the at the Department of Business, Energy & Industrial Strategy (BEIS), January, https://www.oxfordenergy.org/publications/phases-saudi-oil-policy-next/

[3] See Economou, A., Agnolucci, P., Fattouh, B. and De Lipsis, V. (Forthcoming), 'Advancing the Understanding in the Analysis of Oil Price Shocks: Can We Expect the Unexpected?', *OIES Paper*, Oxford Institute for Energy Studies.

[4] Kilian, L. and Murphy, D. P. (2014), 'The Role of Inventories and Speculative Trading in the Global Market of Crude Oil', *Journal of Applied Econometrics*, Vol. 29, pp. 454-478.

[5] See Baumeister, C. and Kilian, L. (2012), 'Real-Time Analysis of Oil Price Risks Using Forecast Scenarios', *IMF Economic Review*, 62(1), pp. 119-145.

The novelty of the underlying structural model used in this paper is that it decomposes the supply shocks into exogenous (i.e. caused by wars or political unrests) and endogenous (i.e. caused by economic, geological or technological factors associated with the normal functioning of the oil market) within a framework that is both theoretically and empirically sound.[6] This distinction is important as the traditional approach of modelling supply shocks (*flow supply shocks*) underestimates the historical contribution of oil supply to changes in the real price of oil.[7] Moreover, as forecast scenarios are developed based on structural shock sequences observed during historical oil price episodes, it is important both for the forecaster and the end-user to understand the relative importance of the various shocks in explaining past price movements.

2. Understanding the oil price slump of 2014-2016

Amid the two-and-a-half-year turmoil in the global oil market, it remains an open question if the oil price slump since June 2014 can be attributed to a persistent supply glut or a delayed oil demand response owing to a structural slowdown of real economic activity primarily in emerging markets.[8] Figure 1 shows how many dollars of the real price of oil can be attributed to supply or demand shocks during the period June 2014 to August 2016, based on the cumulative effect of each structural shock on the real price of oil obtained by the structural model.[9] The estimates of the responses of each model variable to each oil supply and demand shock and the cumulative effect of each structural shock to the real price of oil at each point in time are shown in Appendix A.

The bar chart in the first row of Figure 1 shows the results for June 2014 to August 2016. The second and third rows show the corresponding results broken down by sub-period, representing the short-run effects of each structural shock on the real price of oil in the same period. Overall, it is shown that of the cumulative $49/b decrease in the real oil price over the entire period, $31/b can be attributed to the cumulative effect of the combined supply shocks (exogenous and endogenous), $16/b can be attributed to flow demand shocks and $2/b can be assigned to speculative and other demand shocks.

Results shown in the first bar chart in the second row confirm the conjecture that the oil price collapse from June 2014 to January 2015 (a drop by $50/b) was materialised by a combination of several oil market shocks:

- The easing of the supply disruptions which contributed $11/b to the cumulative price fall (bar 1);
- The persistent positive shocks of non-OPEC supply, primarily driven by the US shale production which contributed $21/b to the cumulative price fall (bar 2);
- The weakening of the global economy which contributed $11/b to the cumulative price fall (bar3);
- Movements in oil inventories, which contributed $10/b to the cumulative price fall (bar 4).[10]

[6] See Economou, A. (2016), 'Oil Price Shocks: A Measure of the Exogenous and Endogenous Supply Shocks of Crude Oil', *OIES Paper WPM 48*, Oxford Institute for Energy Studies, August.

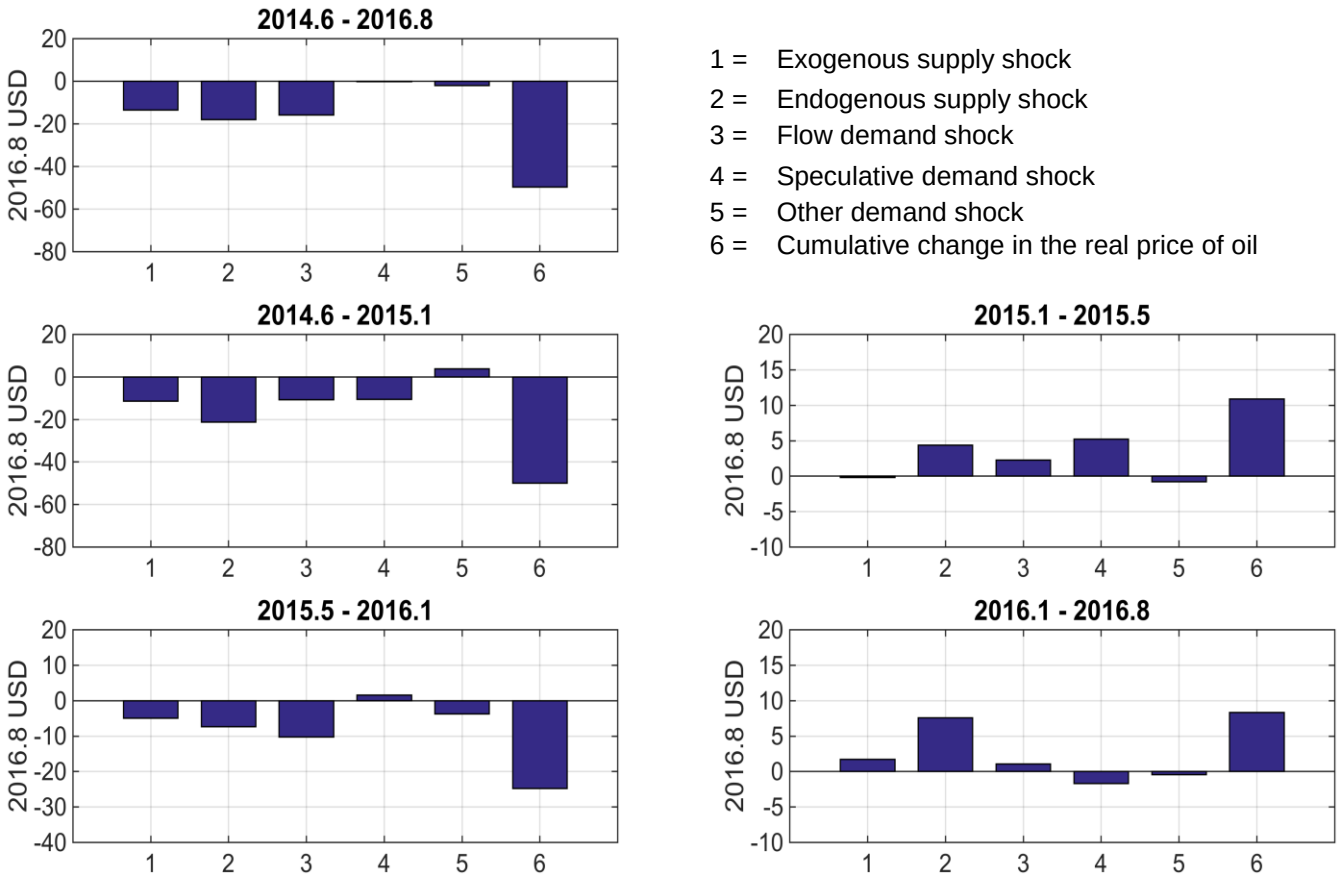
[7] See Economou, A. (2016), 'Oil Price Shocks: A Measure of the Exogenous and Endogenous Supply Shocks of Crude Oil', *OIES Paper WPM 48*, Oxford Institute for Energy Studies, August.

[8] Arezki, R. (2016), 'Rethinking the Oil Market in the Aftermath of the 2014-16 Price Slump', VoxEU.org, August 18. http://voxeu.org/article/oil-market-aftermath-price-slump

[9] The structural VAR of the global oil market proposed by Economou *et al.* (*Forthcoming*) allows for two years' worth of lags and the structural shocks are identified based on a combination of identifying assumptions consistent with the literature. The sample period extends from February 1990 to August 2016 and the model includes five monthly variables: (1) a suitably updated measure of exogenous disruptions in oil production; (2) a suitably updated measure of market-specific capacity shifts in oil production; (3) a measure of fluctuations in global real economic activity proposed by Kilian (2009. 'Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market', *American Economic Review*, 99(3), pp. 1053-1069); (4) the log of the real Dated Brent price; and (5) the change in above-ground oil inventories based on OECD commercial stocks.

[10] Other demand shocks are found to be insignificant throughout contributing between $-3 to $2/b to the price fall (bar 5).

Figure 1: Contribution to cumulative change in real price of oil by structural shock



The oil price recovery near $65/b in the first half of 2015 proved to be temporary. Of the cumulative $11/b increase in the real price of oil from January to May 2015, 50% can be explained by speculative demand shock, while 40% of the total increase can be assigned to the endogenous supply shock. The latter was associated with the collapse of US shale drilling activity by a remarkable 52% in the course of five months. From May 2015 to January 2016, however, the persistent slowdown of Chinese economy and the Eurozone ($10/b), the resilience of US shale production despite the unprecedented drop in the number of rigs ($8/b) and gains in Libyan and Iranian output ($5/b) resulted in a cumulative oil price drop anew by $25/b (down to $31/b).

The first signals of serious rebalancing in the supply-side of the market appeared only after February 2016. Excess supply dropped below the 2.0 mb/d mark for the first time since mid-2014, supported by the robust growth of oil demand and disruptions in oil production originating from Canada, Libya, Nigeria and Venezuela. By March 2016, shortfalls had run ahead of gains in oil production for the first time since June 2014 and the reversal persisted for the remainder of the period, with the imbalance closing at 0.6 mb/d (as of August 2016). As it is shown in the second bar chart in the final row of Figure 1, 90% of the cumulative increase in the real price of oil from February to August 2016 can be attributed to the endogenous supply shock (above $7/b). To the extent that the rest of oil market shocks contributed to the price recovery, about $2/b can be attributed to the exogenous supply shock and $1/b can be assigned to the flow demand shock, while speculative demand lowered the real price of oil slightly by a fraction over $1/b.

3. Real-time forecast scenarios as of January 2017

Forecast scenarios involve modelled projections of the real price of oil in the event of anticipated or hypothetical future supply and demand shocks in the oil market. These allow us to evaluate how sensitive expected changes in the real price of oil under certain assumptions about market conditions are, relative to the baseline forecast. The baseline forecast projects the out-of-sample expected change in the real price of oil conditional on the assumption that there is no change in the expected oil supply and demand conditions. The forecast horizon in all cases is set to sixteen months, extending from September 2016 to December 2017. For expository purposes, all scenarios start in January 2017 and involve future anticipated as well as hypothetical oil supply and demand shocks related to:

(A) The anticipated implementation of the output cut agreement;

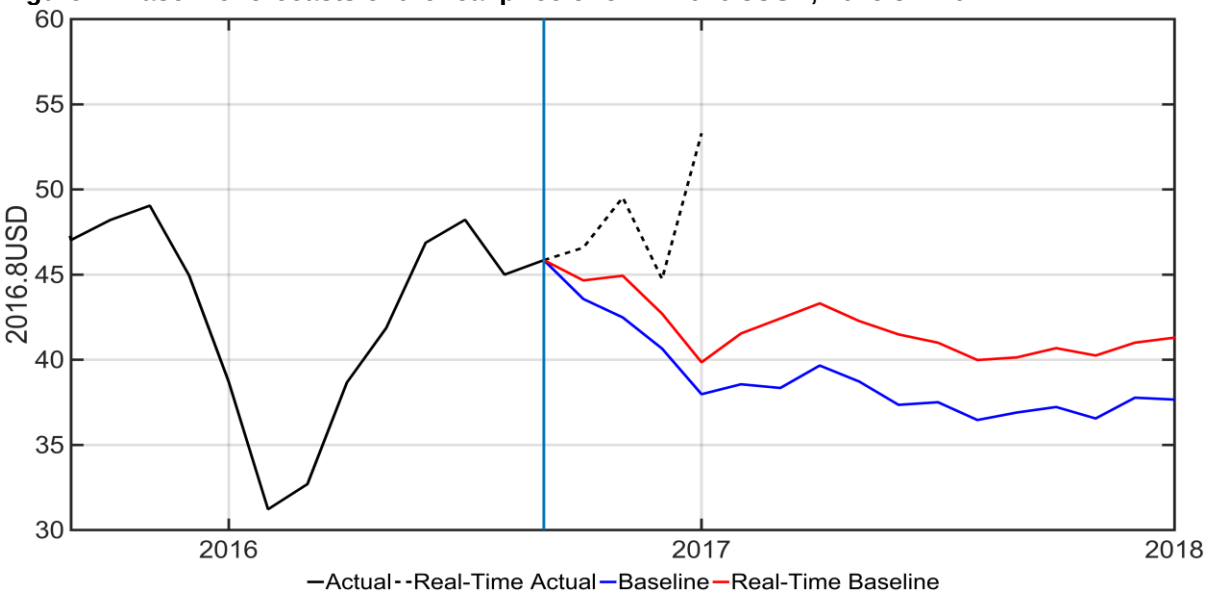
(B) The US shale supply response to a higher oil price;

(C) Shifts in the demand for oil driven by fluctuations in the global business cycle;

(D) Unanticipated disruptions in oil production caused by geopolitical events.

Figure 2 presents the *baseline forecast* of the real price of oil starting in September 2016, accompanied by the actual level of the real oil price extending for the remainder of 2016 based on real-time data. Because our interest lies in 2017, the baseline forecast is revised by feeding in the first four forecast periods a sequence of structural shocks conditional on preliminary data that were available at the time of the forecast (henceforth *real-time baseline forecast)*.[11] Starting from the baseline forecast, the real price of oil falls sharply from $45/b to $38/b for the remainder of 2016, to stabilise in the first half of 2017 to an average of $38/b and decrease slightly by $1/b in the second half. The real-time baseline forecast projects a relatively similar trajectory throughout, with the difference being that the initial oil price decline is delayed by two months and is somewhat limited to $40/b by year-end. Thereafter, the real price of oil increases to an average of $41/b in 2017, $4/b above the unconditional baseline forecast.

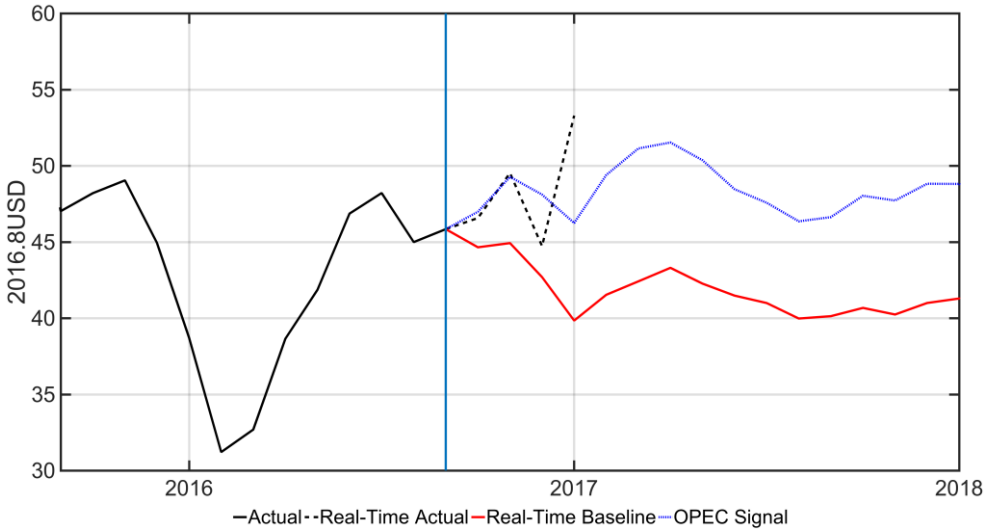
Figure 2: Baseline forecasts of the real price of oil in 2016.8USD, 2015.8 – 2017.12



[11] Specifically, we feed into the model future structural shocks corresponding to sequences of: (1) exogenous supply shocks conditional on the monthly measure of exogenous disruptions in oil production updated to December 2016; (2) endogenous supply shocks conditional on the monthly measure of market-specific capacity shifts in oil production, updated accordingly; and (3) speculative demand shocks conditional on preliminary data for monthly changes in OECD commercial stocks that occurred from September to December 2016.

Both baseline forecasts suggest that from August to December 2016 the real price of oil should have had declined by about $6-8/b. If so, the annual real price of oil in 2016 would have averaged close to $41/b, $2/b below the observed actual. To put these results in perspective, consider the forecasted real price of oil in 2017 based on the real-time baseline forecast. In the absence of any unanticipated supply and demand shocks, the three-year long price collapse would eventually have come to a halt in 2017 based solely on market fundamentals, as the real price of oil would have stabilised at $41/b. Having said that, the actual real price of oil from August to December 2016 increased by $8/b, closing between $13-15/b above the forecasted price year-end. Considering the real-time baseline forecast, however, which is calibrated based on preliminary data about oil supply and demand shocks for the remainder of 2016, it can be argued that the observed surge in the actual oil price cannot be attributed to the underlying supply-demand conditions.[12] In fact, Figure 3 shows that the bulk of the observed increase of the actual oil price can be explained by a positive shift in market sentiment driven by the "*OPEC Signal*".[13] This scenario hypothesises an OPEC collective oil production cut by 1.0 mb/d being enforced in September 2016, motivated by the organisation's announcement after the Algiers meeting that its members are willing to cooperate and enforce a production cut between 0.8-1.2 mb/d.[14] The expected real price of oil increases by as much as $4/b in the first two months and peaks at $51/b in February 2017, $9/b above the real-time baseline forecast. These results suggest that at least 80% of the actual surge in the real price of oil since September 2016 can be attributed to OPEC signalling a shift in its oil policy, which supported market sentiment. Moreover, results indicate that expectations that the oil price could rise much higher than its current levels after the actual enforcement of the OPEC agreement, all else remaining equal, may not materialise.

Figure 3: "OPEC Signal" scenario, 2016.8USD, 2015.8 – 2017.12



Scenario A: OPEC and non-OPEC compliance

Our principal forecast scenario in this section evaluates the extent of the increase in the real price of oil relative to the real-time baseline forecast, under different assumptions about OPEC and non-OPEC compliance to the agreement. Enforcing cuts across OPEC and non-OPEC oil producers beyond very short periods has historically proven very challenging due to the lack of enforcement

[12] Even when the model is calibrated with hypothetical oil demand shocks from August to December 2016, the forecasted oil price increases only by about $1/b.

[13] See Fattouh, B. and Sen, A. (2015), 'Saudi Arabia Oil Policy: More than Meets the Eye?', *OIES Paper MEP 13*, Oxford Institute for Energy Studies, June.

[14] OPEC, '170th (Extraordinary) Meeting of the OPEC Conference', Press Release, 28 September 2016. http://www.opec.org/opec_web/en/press_room/3706.htm

mechanisms.[15] A useful benchmark is therefore a scenario that simulates compliance at 100%, 75% and 50% of the total agreement. We simulate the effects of such reductions on the real price of oil by postulating the occurrence of a one-time structural endogenous supply shock in January 2017 with size corresponding to the three cases above. Because the measure of market-specific capacity shifts in oil production takes into account the available spare production capacity by construction, we adjust the anticipated reductions in oil production based on the level of spare capacity as of December 2016 (1.1 mb/d).[16] Accordingly, the anticipated negative endogenous supply shocks correspond to a 1.15 mb/d, 1.05 mb/d and 0.5 mb/d decline in available operable capacity on impact, respectively. All other future structural shocks are set to zero.

Figure 4: OPEC and non-OPEC compliance scenario, 2016.8USD, 2015.8 – 2017.12

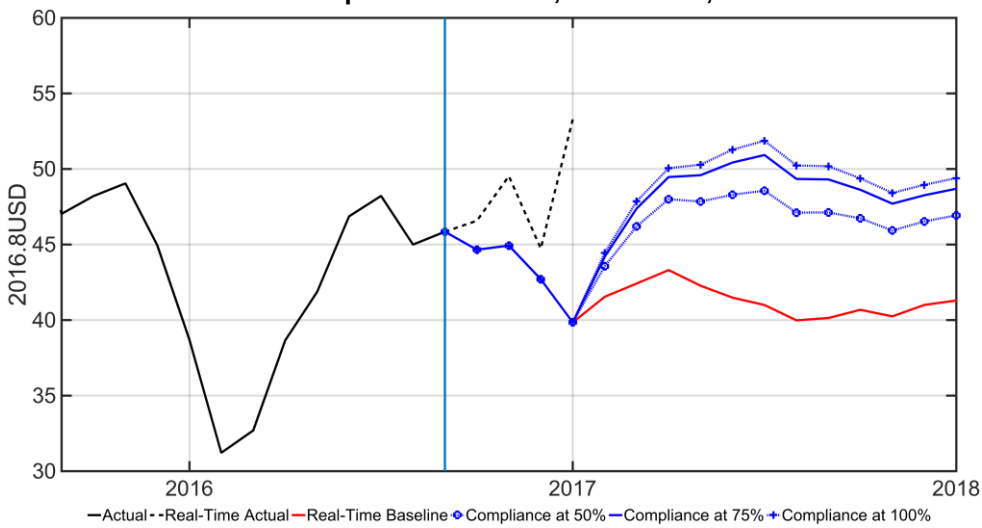


Figure 4 shows that the real price of oil may rise as high as $52/b if OPEC and non-OPEC oil producers abide fully by their agreement or rise up to $48/b if the production cuts are enforced only at 50%. At a compliance level of 75%, the oil price increase falls short only by $1/b relative to the maximum level of compliance, but as compliance drops beyond that threshold, the real price of oil undershoots disproportionally. Depending on the level of compliance, the real price of oil is projected to increase by 12 to 20% y-o-y in 2017, resulting in an annual average increase of $5-8/b relative to the real-time baseline forecast. In the first four months of the scenario, the expected real price of oil increases sharply by $7-11/b, consistent with the actual oil price increase by $8/b observed from September to December 2016. This observation supports the claim that the recent upward movements in the actual price of oil can be attributed to the impact of OPEC signalling on market sentiment. But as the current market price already reflects the bulk of the expected gains from the enforcement of the OPEC agreement, the real price of oil is more sensitive to the downside depending on the discipline of the OPEC and non-OPEC producers.

Lastly, we observe that in all three cases of compliance, the real price of oil peaks after six months and drops by $2/b year-end, between $46-49/b. These results suggest that in the absence of any other supportive structural shocks to the price recovery, either an unexpected growth in global oil demand, or an unexpected disruption in oil supply, or both, OPEC may wish to consider extending or even revising its agreement during the next ministerial meeting in May 2017 to maintain the current oil price.

[15] Fattouh, B. and Mahadeva, L. (2013), 'OPEC: What Difference has it Made', *OIES Paper MEP3*, Oxford Institute for Energy Studies, January.
[16] See Economou (2016, p. 22).

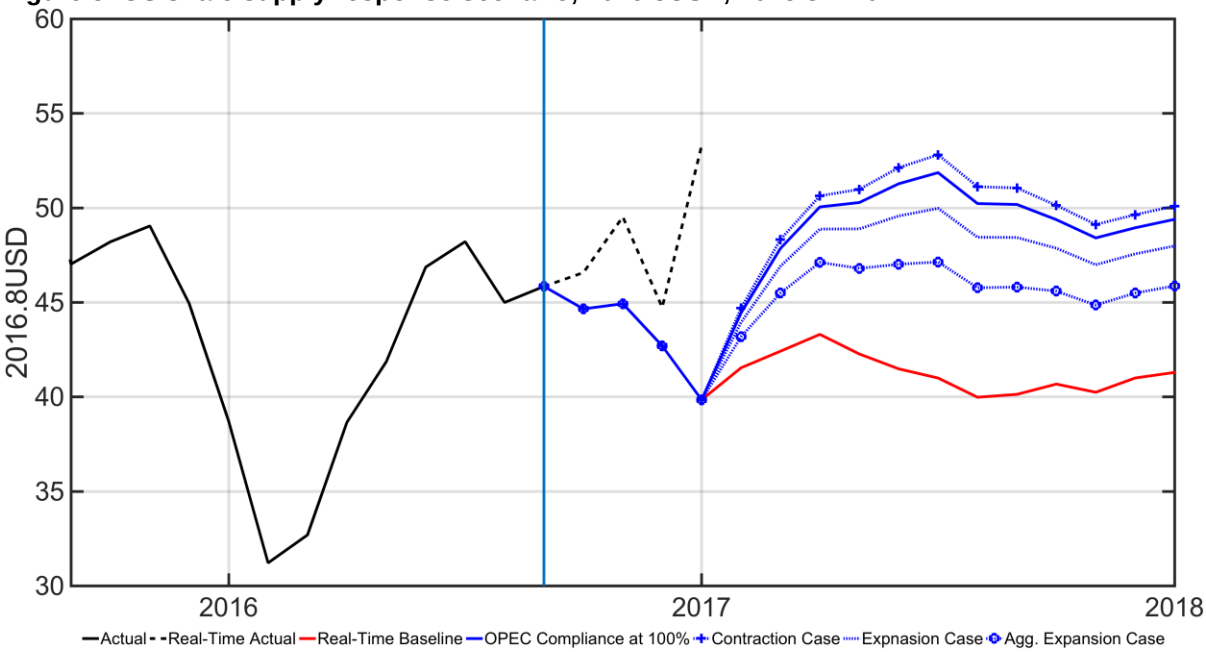
Scenario B: US shale supply response

Having shown that the OPEC agreement to curb its output is expected to help accelerate the recovery of the real price of oil by $5-8/b y-o-y, we now turn to the related issue of how other unexpected oil market shocks could undermine or support the price recovery in 2017. For this task, we assume full compliance to the agreement for all remaining forecast scenarios. The first hypothetical scenario involves three alternative assumptions about the US shale supply response to the expected increase in the real price of oil. These involve:

1. An unanticipated annual decline in US shale oil production by 0.1 mb/d y-o-y (*contraction case*);
2. An unanticipated annual increase by 0.2 mb/d y-o-y (*expansion case*);
3. An unanticipated surge in shale oil production by 0.5 mb/d y-o-y (*aggressive expansion case*).

Figure 5 shows that the contraction scenario implies a limited upward adjustment in the real price of oil by $1/b (from 49/b on average based on the OPEC compliance forecast), followed by the expansion scenario that limits the price recovery by $2/b and the aggressive expansion scenario that undermines the expected oil price increase by $5/b. These results reaffirm the importance of US shale supply response in shaping price dynamics, suggesting that if the US shale oil producers are able to increase production sharply which results in loss of OPEC market share and diminishing oil revenues, OPEC may be forced to revisit its current strategy.

Figure 5: US shale supply response scenario, 2016.8USD, 2015.8 – 2017.12



Scenario C: Global economic activity

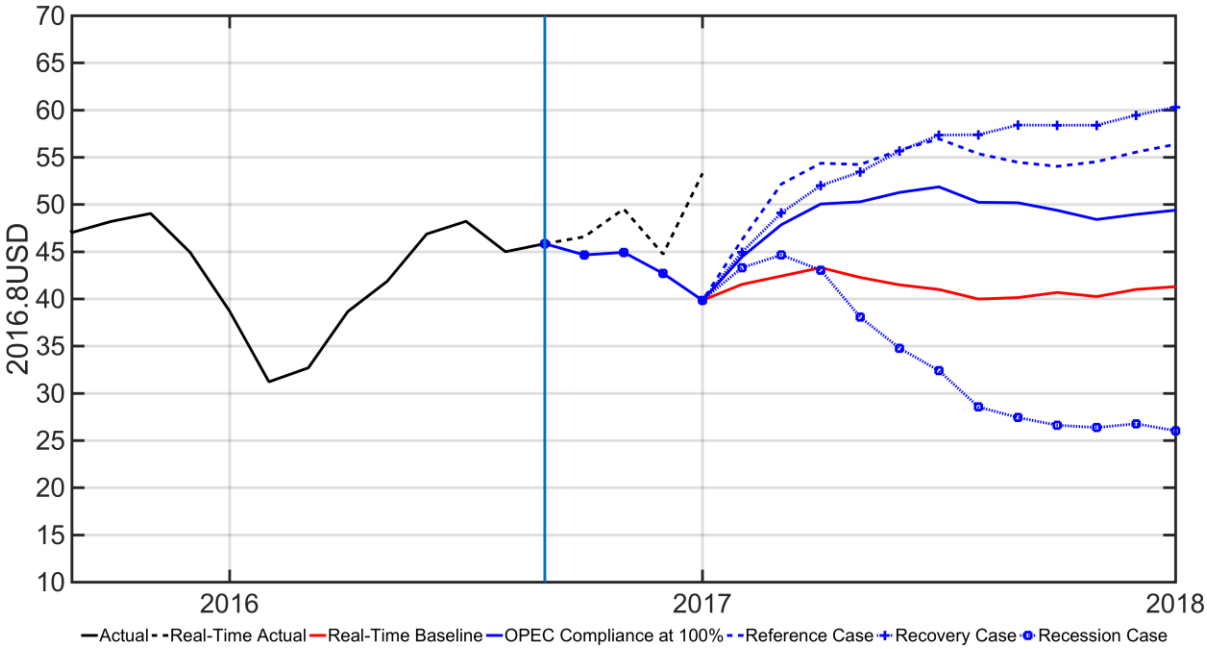
The second hypothetical scenario involves alternative assumptions about three unanticipated flow demand shocks related to fluctuations in the demand for oil and other industrial commodities:

1. The *reference case* simulates how unexpected shocks in oil demand like those that occurred between March 2016 and August 2016 would affect the recovery of the real price of oil in 2017. This scenario is motivated by the strong consensus that exists among industry sources that oil demand in 2017 is anticipated to grow at a similar rate as in 2016 (between 1.2-1.4 mb/d).
2. The *global recovery case* assesses how an unexpected surge in the demand for oil similar to that occurred between November 2007 and July 2008 could help accelerate the price recovery.

3. The *global recession case* involves a global collapse in oil demand similar to that occurred during the 2008 global financial crisis, which is simulated by feeding into the forecast the observed sequences of flow demand shocks from September to December 2008.

Figure 6 shows that if the growth of global oil demand in 2017 carries a similar momentum as last year, this could add up to $5/b in the expected oil price increase following the OPEC agreement, stabilizing the real price of oil on average near $55/b. That said, any unexpected revisions from current projections to the upside could help support the oil price recovery even further, as the forecast raises the expected oil price to $60/b by year-end. On the other hand, the recurrence of a global recession comparable to 2008 would be expected to dramatically lower the real price of oil by up to $23/b, as the forecast nosedives below $30/b after six months and the expected oil price settles down to $26/b year-end.

Figure 6: Global economic activity scenario, 2016.8USD, 2015.8 – 2017.12



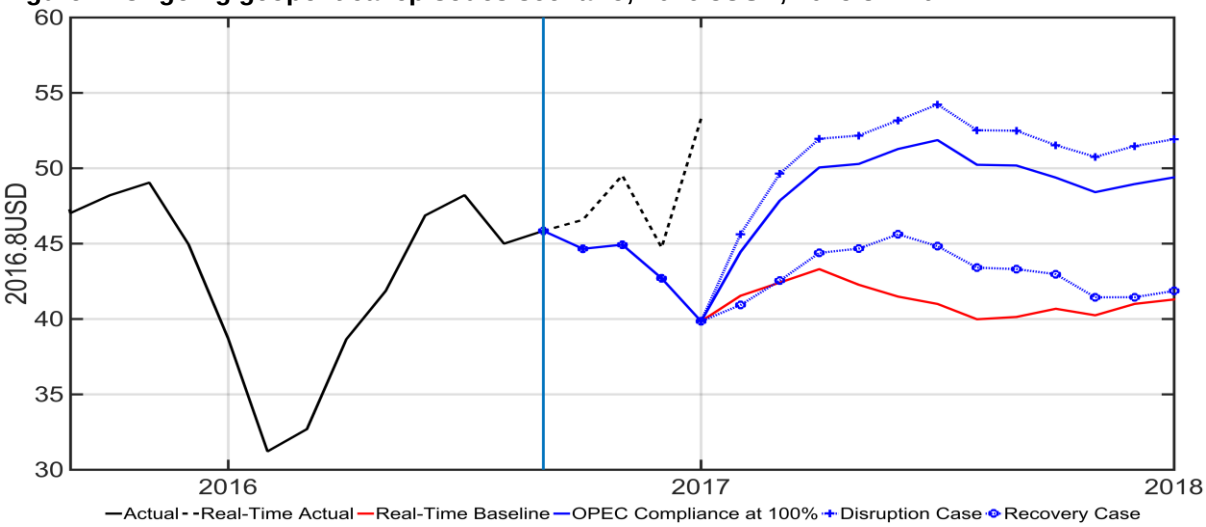
Scenario D: Geopolitical episodes

The final hypothetical scenario involves the unexpected disruption or recovery in global oil production caused explicitly by geopolitical events that translates to an exogenous supply shock. We divide this scenario into the *ongoing geopolitical episodes* and the *extreme geopolitical episodes*. Starting from the ongoing geopolitical episodes, the *disruption case* involves an unexpected disruption in oil production of 0.41 mb/d originating from Libya and Nigeria. This corresponds to a loss of 0.27 mb/d from Libya and 0.14 mb/d from Nigeria motivated by comparing their most recent actual levels of oil production to their most recent observed lowest caused by conflict (as of May 2016). The *recovery case* involves an unexpected return of Libyan and Nigerian oil production by 0.55 mb/d. As Libya and Nigeria are exempted from the OPEC agreement because of the ongoing output losses caused by conflict, an obvious question of interest to market participants is whether an unexpected return of oil production from these two producers could jeopardise the OPEC agreement from within. Following a counter-rational, the total amount of recovery corresponds to a return of Libyan oil production to 0.87 mb/d (as of August 2014) and a return of Nigerian oil production to 1.81 mb/d (average in 2015), from 0.59 mb/d and 1.59 mb/d respectively.

Figure 7 shows that the disruption case initially adds about $3/b to the expected recovery of the real price of oil in the first half of 2017, but after the real price of oil peaks near $55/b, it then falls back to $51/b year-end. This relatively modest impact on the expected oil price recovery can be attributed to the fact that after the implementation of the agreement, there is more available OPEC spare capacity

that could be used to offset these losses in production. On the contrary, the recovery scenario shows that the impact from a potential recovery in Libyan and Nigerian oil production could dramatically undermine the OPEC agreement by around $8/b and by the end of the year it could offset all the expected gains in the real price of oil. This result highlights how fragile is the OPEC agreement from within the organisation, adding to the uncertainty pertaining to a sustained recovery of the real price of oil in 2017. At this point we must note the uniqueness of the underlying structural model in terms of its ability to differentiate between supply shocks that are market-specific (endogenous) from those caused by events outside the oil market (exogenous), in modelling oil price expectations under different assumptions about the supply determinant. The importance is that the responses of the real price of oil to each category of supply shocks differ greatly.[17]

Figure 7: Ongoing geopolitical episodes scenario, 2016.8USD, 2015.8 – 2017.12

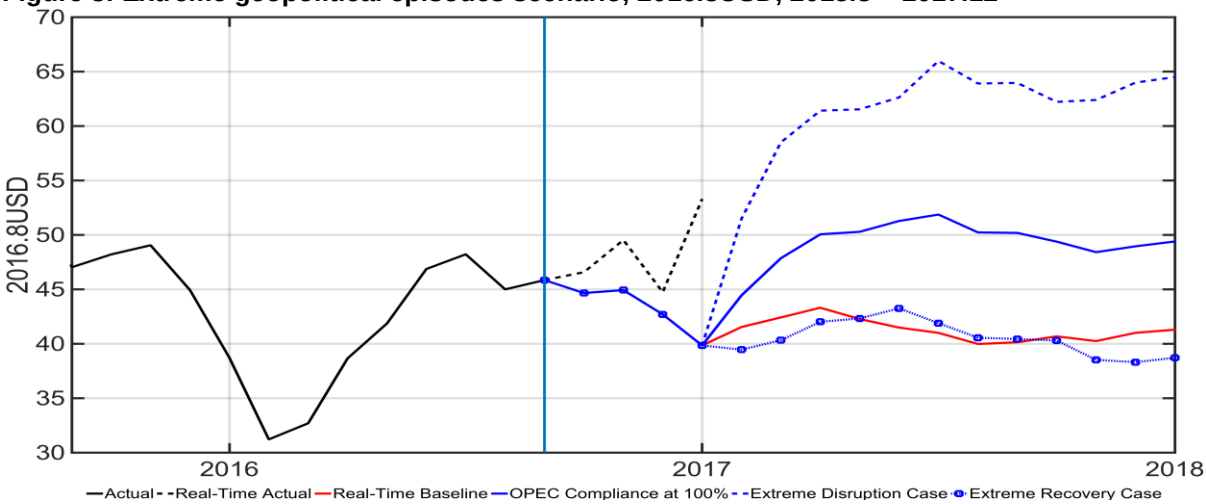


We conclude with two extreme geopolitical episodes. The *extreme disruption case* involves shutting down 80% of the total Venezuelan oil production caused by the ongoing political and economic crisis. This corresponds to a loss of 1.64 mb/d and is motivated by the observed amount lost during the 2002 Venezuelan oil strikes. The *extreme recovery case* involves an unexpected return of Libyan oil production to its pre-shock level of 1.42 mb/d as observed in April 2013. Despite the chaotic situation on the ground over who is in control over Libya's oil and gas resources, the physical damage on oil infrastructure is relatively minimal. That said, the ability of Libyan oil production and exports returning to the market is largely dependent on whether political stability could be sustained in the long-term. Therefore, emphasising that there are still many challenges to overcome, the scenario simulates an unexpected stimulus in Libyan output by 0.87 mb/d.

Figure 8 shows that in the event of an unanticipated disruption in Venezuelan oil production similar to December 2002, the real price of oil could spike up to $66/b and average $12/b higher than the expected price increase associated with the full enforcement of OPEC production cuts. On the other hand, an unexpected return of Libyan output to its pre-shock level could drag the expected oil price below the real-time baseline forecast by $1/b on average for 2017, settling at $38/b year-end. Overall, on the upside, the geopolitical scenarios suggest that an unanticipated disruption in oil production between 0.4-1.6 mb/d may add between $2-12/b to the expected recovery of the real price of oil in 2017. On the downside, the price risk is much higher considering that even if an unanticipated recovery in oil production originating from conflict inflicted counties is only half as much as the amount of the production cuts agreed between OPEC and non-OPEC producers (1.6 mb/d), it may absorb all the expected gains in the real price of oil.

[17] See Economou (2016, p. 28).

Figure 8: Extreme geopolitical episodes scenario, 2016.8USD, 2015.8 – 2017.12



4. Oil price paths in 2017

Having considered a range of alternative forecast scenarios pertaining to changes in the expected recovery of the real price of oil motivated by the OPEC agreement relative to distinct unexpected oil supply and demand shocks, we now combine these scenarios to assess the oil price path in 2017 under a set of assumptions relating to future market conditions (Table 1). These assumptions have been discussed in Section 3. The full range of the final forecast scenarios illustrates how the real price of oil could evolve in 2017 based on three principal cases: *the reference case*, *the optimistic case* and the *pessimistic case*. An additional distinct unexpected oil market shock is then added to each one of the principal cases, associated with the revised extension of the OPEC agreement by 1.2 mb/d (*2nd OPEC Agreement Case*), the collapse of the Venezuelan oil production by 80% (*Extreme High Case*) and the return of Libyan output to pre-shock level (*Extreme Low Case*), respectively. The former additional scenario we introduce in this section is motivated by the provision in the OPEC agreement that the organisation is to consider extending its production cuts in its next ministerial meeting, in effect from June 2017.

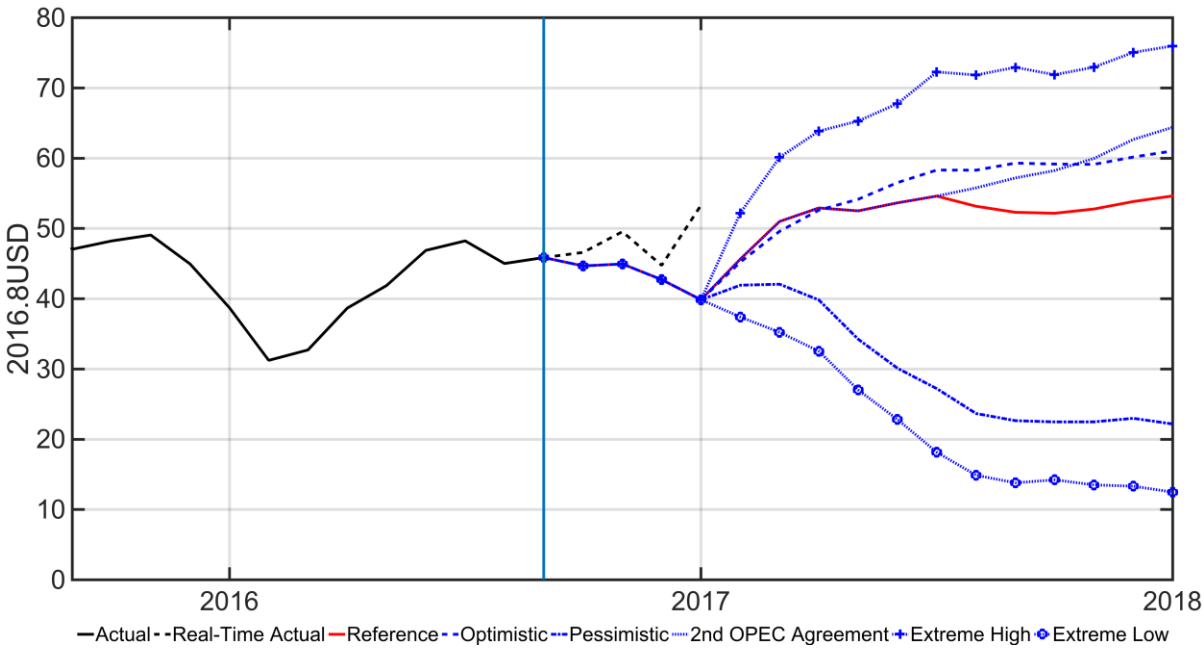
Table 1: Set of alternative assumptions about future market conditions

Scenarios	Reference	Optimistic	Pessimistic	2nd OPEC Agreement	Extreme High	Extreme Low
OPEC Compliance	75%	100%	50%	75%	100%	50%
US Shale Supply Response	Expansion	Contraction	Aggressive Expansion	Expansion	Contraction	Aggressive Expansion
Global Economic Activity	Reference	Recovery	Recession	Reference	Recovery	Recession
Geopolitical Episodes	n/a	n/a	n/a	n/a	Venezuelan Crisis	Libyan Recovery
2nd OPEC Agreement as of June 2017	n/a	n/a	n/a	1.2 mb/d	n/a	n/a

Figure 9 shows that the real price of oil in 2017 may average between $21-68/b under these very different scenarios. Recall that our starting point is $40/b as of December 2016. Starting first from our principal scenarios, under the reference case, the expected oil price rises to $54/b in the first half of 2017, where it stabilises for the remainder of the year. Under the optimistic case, the real price of oil is expected to gradually increase up to $61/b year-end and generate annual gains of $4/b on average relative to the reference case. Under the pessimistic case, the expected oil price falls sharply by $18/b in the first eight months and stabilises at $22/b for the remainder of the year. On average, the real price of oil is expected to record an annual loss of $20/b relative to the reference case.
Effectively, the results obtained by our principal scenarios suggest that a 75% rate of compliance to the production cuts accompanied by a growth rate of oil demand similar to last year, as well as a moderate expansion of US shale supply would be expected to drive the recovery of the real price of oil close to $52/b. On the upside, an unexpected surge in oil demand amid a depressing response from the US shale producers could help the oil price recovery break the $60/b mark. However, the failure of OPEC and non-OPEC producers to commit to their production cuts in conjunction with unfavourable market conditions could drag the oil price below $30/b, resulting to a collapse that could be twice as much more severe than a surge in price under the optimistic scenario. The latter highlights the high sensitivity of the expected oil price to downside risks.

Finally feeding into the preceding principal forecasts an additional discrete structural shock, we may observe first that a revised extension of the OPEC agreement as of May 2017 (2nd OPEC agreement case) raises the reference forecast in the second half of 2017 by $6/b on average, pushing the expected real price of oil to $64/b year-end. That is $3/b above the optimistic forecast, highlighting the importance of extending the OPEC agreement to the end of 2017. This does not necessarily mean that OPEC oil producers should commit to further production cuts, but rather that the organisation has the option of extending the agreement to offset any losses to the anticipated recovery of the real price of oil that may occur owing to non-supportive market conditions.

Figure 9: Oil price paths in 2017, 2016.8USD, 2015.8 – 2017.12



Moving lastly to the geopolitical episodes, feeding a negative exogenous supply shock to the optimistic forecast that is associated with a hypothetical Venezuelan Crisis in 2017, results in a sustained increase in the real price of oil up to $76/b year-end. On the contrary, a positive exogenous supply shock associated with an unexpected return of Libyan output revises downwards the pessimistic forecast and results to an expected oil price collapse at $12/b. While these last two

scenarios are less plausible than all the rest discussed so far, they do however provide useful insights regarding the limits and the robustness of our modelled projections throughout.

5. Conclusions

Looking ahead in 2017, our structural model suggests that the upside potential from current price levels is rather limited, but the market fundamentals have been tightening and prices are moving in the right direction. Even without the OPEC intervention, the three-year long price collapse would eventually had come to a halt close to $41/b in 2017 based solely on market forces. The implementation of the OPEC-non-OPEC output agreement, however, helped accelerate the recovery by stabilising the oil price near $50/b. That said, the current market price at above $50/b may already incorporate the bulk of the expected gains from the full enforcement of the production cuts and reflects the positive shift of market sentiment that has been building-up in anticipation of the agreement. Thus, the oil price path is more sensitive to downside risks, depending on the discipline of OPEC and non-OPEC producers at or above a 75% level of compliance. Yet, for the price recovery to be sustained in 2017, OPEC efforts must be met with favourable market conditions in the form of an unexpected surge in global oil demand amid a moderate expansion of US shale supply. On the contrary a renewed deterioration of global economic activity, or an aggressive expansion of US shale supply, or both, could reverse the current momentum. A return of oil production from conflict inflicted countries Libya and Nigeria could significantly undermine the OPEC agreement from within. Eventually, whatever scenario plays out, OPEC will continue to assess the market conditions and in the second half of 2017, it can decide on whether to extend the agreement to offset any losses to the anticipated oil price recovery that may arise from changes in oil market conditions or to drop the agreement all together. But regardless which way the decision goes, the latest output cut agreement is critical to resolving fundamental uncertainties about the shock hitting the oil market and OPEC behaviour in a more uncertain world.

Appendix A

Figure A1: Responses of the structural model variables to each of the structural shocks

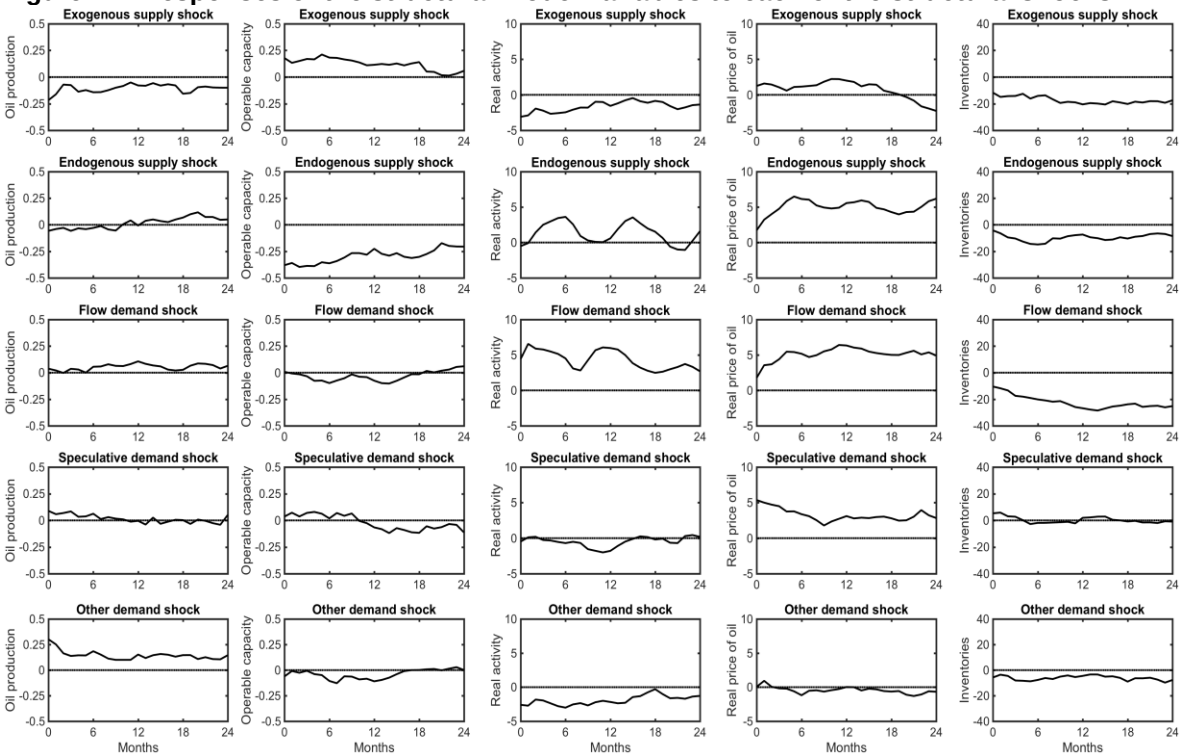
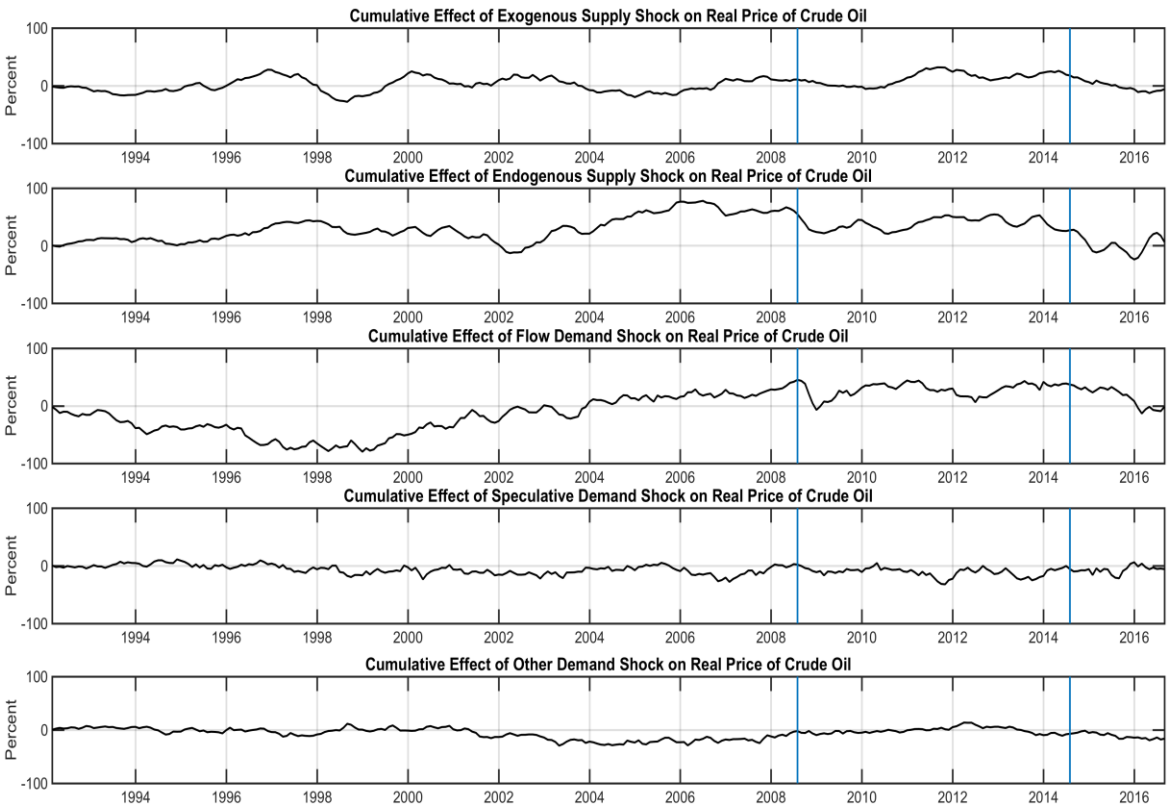


Figure A2: Historical decomposition of the real price of oil for 1992.2 – 2016.8



* Andreas Economou, OIES-Saudi Aramco Fellow, OIES and UCL Energy Institute;
Bassam Fattouh, OIES; Paolo Agnolucci, Senior Lecturer, UCL Institute for Sustainable Resources;
and Vincenzo De Lipsis, Research Associate, UCL Institute for Sustainable Resources.
Corresponding author, Andreas Economou. Email: andreas.economou.13@ucl.ac.uk