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Fundamental Analysis of Oil Price Movements in 2010s'1

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Abstract- The oil market has proved its cyclical nature once again in recent years. After several years with price hovering above 100 USD/bbl, increased investments and consequential excessive supply caused oil prices to fall and OPEC started with active supply management. This article examines the supply and demands factors that determine the current lack of success of OPEC's activities. We think that OPEC's need for immediate increase in budget revenues helped the shale oil producers to increase their activity which results in current protracted period of low prices, with potential result of another boom cycle. We do not expect that demand will decrease in large enough scale to prevent another price spike in coming years as a result of current environment of low exploration and production investments.

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Fundamental Analysis of Oil Price Movements in 2010s'1

Saleh Mothana Obadi[α] & Matej Korcek[σ]

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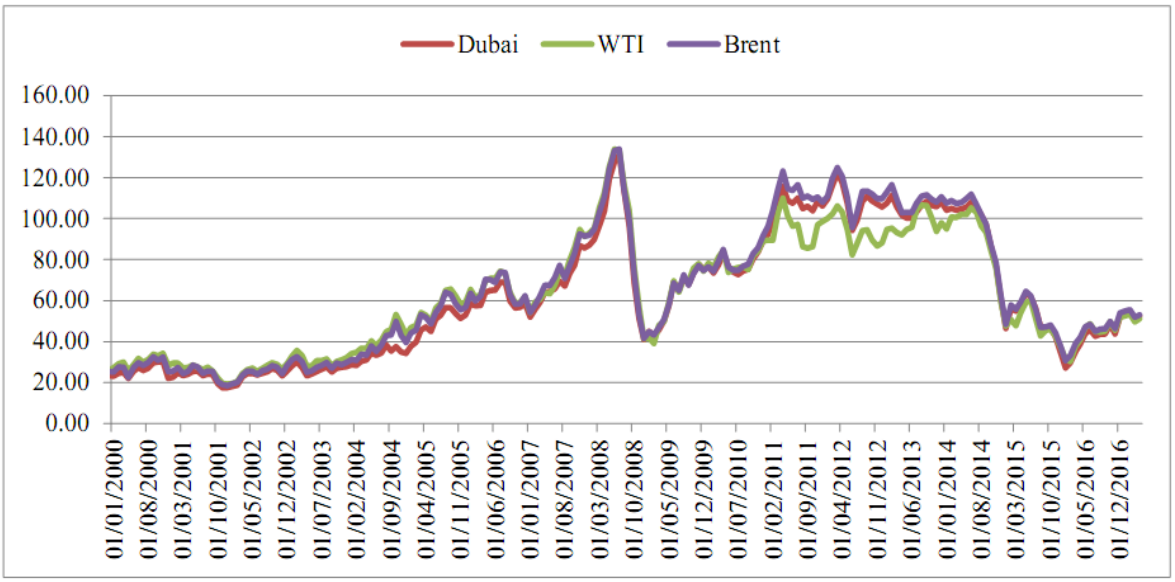
I. Introduction

OPEC's decision to limit its output in November 2016 came two years after it unexpectedly announced it will not change its production quota in 2014, after oil prices declined 30% from its 2014 high of August's average 111.87 USD/bbl to November's 78.44 USD/bbl. During previous three years (2011-2013), OPEC had little trouble keeping prices in the 100 USD/bblrange, that many of its members considered satisfactory. OPEC's decision to flood the market came as non-OPEC originated surplus production resulting from the strong unconventional production growth, especially in US(which according to EIA data increased its liquid fuel production by staggering 46% from 9.7 to 14.3 mbd between 2010-2014) have kept cutting into market share of OPEC . Since during that periodglobal supply increased only by more moderate 10 % or 10 mbd and OPEC's intention was widely interpreted as a decision to fight the surge of American higher cost producers. This decision caused the oil prices to fall by 60 % to just 30.8 USD/bbl in January 2016. This episode was basically another example of boom and bust cycles of oil market, when previous period of high oil prices attracted more investments which caused exceeding production. This time though, unlike in the 1980's the marginal barrels were not arriving from discoveries of brand new fields but as a result of strong technological move that enabled the production of previously not accessible resources trapped in shale and tight sands. The initial move of OPEC seemed to be reasonable as marginal production costs of "shale oil" were significantly above that of OPEC and most analysts predicted that American producers will not be able to withstand the drop in oil prices which would quickly balance the market.

Graph 1: World oil markers' prices



Source: IMF, Primary Commodity prices

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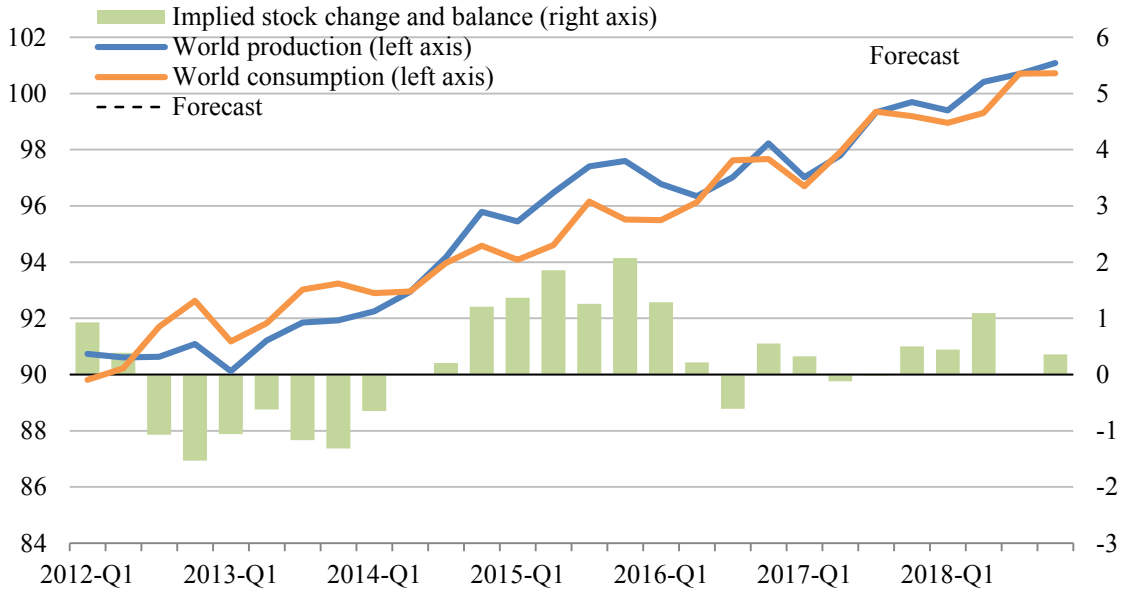
As we stated, the initial impetus to for discussion of quotas was the imbalance on the oil market that reached its peak in 2014. During that single year the total annual supply increased from 92.25 mbd to 95.79 mbd, increase of 3.86 mbd, while the demandrose from 92.9 to 94.58 mbd, which meant the significant build up of commercial stocks in OECD countries. At the beginning of 2014 they were at the lower end of 5 years average band, but continuously started increasing from 54.7 days of consumption in January 2014 to more than 65 days of consumption in 2016. As that growth of stocks suggests, 2015 did not altered the supply-demand imbalance.The first reason for that was the price retracement, whenoil prices averaged above 60 USD/bbl in second quarter of 2015 before sinking to lower 40's during thelast quarter of the year. This gave American producers some time to not only hedge the price of production but also to take steps to optimize its costs, which actually enabled themto increase their annual production by another 652 kbd. Situation changed in 2016, when oil prices for the whole year averaged only 44USD/bbl, down some 8 USD/bbl from the previous year, bottoming out in the first quarter of 2016 with January's average of 30.8 USD/bbl. Such low prices already delivered the expected initial shift in supply-demand balance, when the consumption grew by just 360 kbd while consumption in 2016 increased by healthy 1,64mbd with inevitable drawdown of OECD commercial crude stocks that decreased by 118 mb to 2967 mb.

Graph 2: World liquid fuels production and consumption balance (mbd)



Source: EIA, Short term energy outlook

The supply cut was especially visible in the US as its crude output declined by 540 mbd and the overall drilling activity almost halted when the count of active oil rigs in US fell from its high of nearly 1600 in 2014 to some 300 in 2016. However the price slump hit equally hard the OPEC producers, that lost 54 % (513 bilion USD) of its oil related incomes between 2014-2016, and needed to quicken the price rebound in order to stabilize their state budgets situation. With that in mind, at the end of 2016 OPEC led by Saudi Arabia announced 1.2 millions of barrels per day (mbd) cut in its production for the period of first half of 2017. This effort was joined by some non-OPEC countries led by Russia adding to the cut another 600 thousand barrels per day (kbd) effectively so pulling1.8 mbd from the market in order to support prices. This step basically meant the shift in the strategy that largest oil producer chose previously face to face emerging shale production in the US. The aim of this article is to analyze what led to this situation as well as recent developments on the oil market. We look at the supply demand – balance, evolution of price in order to provide holistic assessment of current oil energy market.

II. Demand

Oil continues to be integral part of global economy. Despite the strong push for renewable energy sources its consumption continues to grow by 1.4 % so far in the twenty first century in comparison to 1.2 % in the previous two decades. In real terms it means nearly doubling of average yearly incremental consumption from 618 kbd in first period to 1 619 in the later one. Despite that, discussion about peak oil, which dominated the oil related energy-environmental debate switched to debate reflecting the possible peaking of demand for oil. Reason for that is the fact demand for oil in the West is falling. The decline in oil demand largely reflects the improving efficiency of motor vehicles as

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transport is by far the largest oil consumption area. For instance the fuel economy of new cars in the US, measured in terms of miles per gallon, around 20% higher than 10 years ago (IEA,2016).According to various analysts, this trend will only strengthened as the internal combustion engine will be replaced by alternatives in ever faster rising rate. This should effectively cap any future rise in oil demand which should start its ultimate decline in coming decades – we analyze this thesis later in the article.

Oil consumption in the US and Europe peaked about 10 years ago and has been on a downward trend ever since. The aggregate OECD consumption was surpassed by its non-OECD counterparts in 2013 and they started to slide apart for few years before the fall in oil prices which led back to slight rebound for oil demand in developed economies which is now forecasted to increase till 2018 back to its levels from 2010 (EIA, 2017). As the demand of developed countries slowed down, it was more than offset by fast growing emerging markets especially that of China and India which combined increase of incremental demand for oil reached almost 4 mbd between 2010-2016 and is expected to increase another 1 mbd during 2016-2018 period based on strong economic growth and rise of middle class. Even so, current percapita annual oil consumption in China, at around 3 barrels per capita remains well below that in the United States (20 barrels per capita) and the European Union (8 barrels per capita). There are signs of a slowdown, but the era of robust Chinese oil demand growth is not over according to IEA (2016), which projects China to grow by around 300 kbd each year for the next ten years and only then slowsto an average annual increase of 100 kbd from 2025 onwards. During that period China overtakes the UnitedStates in the early 2030's to become the world's largest oil consumer, but China's projected increase in consumption over the next 25 years (4.1 mb/d) is less than half what was added in the previous 25 years (8.6 mb/d).

The second region of strong demand of growth for oil happened to be Middle East with 0.9 mbd in first and 0.6 mbd incremental demand in second observed period. This development happened to be concern for those countries as less oil becomes available for export which together with low oil prices significantly affects their crucial governmental revenue.

Table 1: Liquid fuels consumption (mbd)

Country/Region	2010	2011	2012	2013	2014	2015	2016	2017	2018
North America	23.66	23.42	23.07	23.51	23.56	23.95	24.03	24.25	24.55
United States	19.18	18.88	18.49	18.96	19.11	19.53	19.63	19.92	20.22
Canada	2.38	2.4	2.47	2.45	2.41	2.41	2.43	2.42	2.41
Mexico	2.1	2.12	2.1	2.09	2.04	2.01	1.95	1.9	1.9
Central and South America	6.6	6.74	7.05	7.11	7.27	7.16	7.13	7.12	7.11
Brazil	2.7	2.78	2.92	3.03	3.14	3.11	3.04	2.99	2.94
Europe	15.45	14.96	14.47	14.32	14.24	14.49	14.84	14.97	15
Eurasia	4.27	4.61	4.58	4.6	4.85	4.83	4.86	4.97	5.09
Russia	3.14	3.42	3.45	3.49	3.69	3.6	3.59	3.69	3.79
Middle East	7.66	7.84	8.23	8.22	8.51	8.48	8.56	8.9	9.2
Africa	3.52	3.45	3.64	3.8	3.98	4.1	4.27	4.4	4.54
Asia and Oceania	28	28.87	30.04	30.76	31.19	32.09	33.05	33.7	34.45
China	9.53	10.05	10.55	11.08	11.49	12.01	12.44	12.78	13.12
India	3.31	3.46	3.62	3.66	3.74	4.03	4.35	4.56	4.82
Japan	4.33	4.34	4.63	4.5	4.27	4.12	3.99	3.84	3.76
non-OECD	42.14	43.52	45.13	46.21	47.8	48.73	49.88	51.15	52.48
OECD	47.04	46.36	45.96	46.11	45.81	46.37	46.86	47.15	47.45
World	89.18	89.88	91.1	92.33	93.6	95.1	96.74	98.3	99.93

Source: EIA, Short Term Energy Outlook (May, 2017)

Even though the demand for oil is widely considered to be only slightly elastic, our empirical observation suggests that economic growth together with oil prices still drive the demand for oil to a certain extent. Looking at the advanced economies, we can conclude that period of slower economic growth accompanied by high oil prices resulted in slow growth of oil consumption between 2010-2016, the stronger economy supported by current low oil prices however coincide with the expected stronger growth in oil consumption in next two years. The opposite observation can be made about developing countries which strong growth from previous years inadvertently led to strong incremental growths of the oil consumption, with projected slowdown in coming years. This causality is even multiplied as high oil prices fuelled some of the economic growth in the group of developing countries.

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Table 3: Economic growth of selected entities

	2010	2011	2012	2013	2014	2015	2016	2017	2018
World	5.4%	4.2%	3.5%	3.4%	3.5%	3.4%	3.1%	3.5%	3.6%
Advanced economies	3.1%	1.7%	1.2%	1.3%	2.0%	2.1%	1.7%	2.0%	2.0%
Developing economies	7.4%	6.3%	5.4%	5.1%	4.7%	4.2%	4.1%	4.5%	4.8%
European Union	2.1%	1.7%	-0.4%	0.3%	1.7%	2.4%	2.0%	2.0%	1.8%
China	10.6%	9.5%	7.9%	7.8%	7.3%	6.9%	6.7%	6.6%	6.2%
USA	2.5%	1.6%	2.2%	1.7%	2.4%	2.6%	1.6%	2.3%	2.5%

Source: IMF, World Economic Outlook Database 2017

As we mentioned before, transportation represents about 2/3 of global oil demand, therefore the evolution on the field of alternative fuelled vehicles is especially important for estimation of future oil consumption. In 2015, the global stock of EVs climbed to 1.3 million, a near doubling of the stock in 2014 (IEA, 2016). Although the share of electric cars in the global vehicle stock is still only 0.1%, this is a marked improvement from historic levels. Momentum has been broadly maintained over the first-half of 2016, as registrations in the European Union rose by around 20% and 130% in China, compared with the first half of 2015. China is now the largest market for EV sales, followed by the United States. The increase in sales has been accompanied by growth in the supply of EV support equipment. The number of publicly accessible chargers in 2015, for example, is estimated to be 190 000 globally, up from 110 000 in 2014. The recent rise of EVs has emerged both as a result of continuous technological improvements and because of mounting policy support. Since 2008, research, development and deployment, as well as growing battery use in markets such as consumer electronics, have contributed to a four-fold increase in battery energy density. Costs have also fallen to less than 270 USD per kWh for batteries used in plug-in hybrid vehicles and about 210 USD/kWh for battery electric vehicles. Such improvements offer extended electric driving ranges at lower costs. Countries with the highest uptake of electric cars have typically made use of vehicle purchase incentives, including subsidies and tax incentives, and invested in the deployment of recharging infrastructure to support deployment. Ambitions for the future deployment of EVs are high: Tesla Motors targets 0.5 million annual electric vehicle sales by 2018(from 50 000 in 2015); Renault-Nissan aims for cumulative sales of 1.5 million EVs by 2020; Volvo aims to sell 1 million EVs by 2025 and Volkswagen recently announced a strategic shift to EV's and aims to launch 30 battery electric vehicles models and achieve annual sales of 2-3 million by 2025 (IEA, 2016). Those plans of private companies are indeed accompanied by national targets in some countries.

Table 2: Electric vehicle deployment targets by country

Country	Electric car targets
China	Stock target of 4.6 million in 2020
France	Stock target 2 million (2020)
Germany	Stock target 1 million (2020)
India	Stock target 200 000-400 000 (2020)
Japan	Stock target 1 million (2020), sales share target 50-70% (2030)
Netherlands	Sales share target: 30% (Battery EV), 20% Plug-in hybrids (2025)
Norway	Stocks target 50 000, already exceeded
United Kingdom	Sales share target 16 % (2020),60% (2030), 100% (2040)
United States	Stocks target 3.3 million (2025) across 8 states

Source: IEA, World Energy Outlook 2016

IEA (2016) predicts electric vehicles will grow from 1.5million today to 30 millions in 2025 and 150 millions in 2040. To put things into perspective, this would have according the IEA's prediction replaced some 6 mbd of oil consumption.

To recap, oil demand grew at 1.64 mbd in 2016, which is lower than during 2015. EIA expects demand growth to slow slightly to 1.56 mbd in 2017 but then jump up back to 1.65mbd – significantly above the 0,93mbd average of two previous decades. Amid a significant cutback in production, such fairly robust demand could significantly help to balance out the supply demand equation, as the main hope for ultimate move away from oil – decrease in oil use in transportation seems to be still several decades away.

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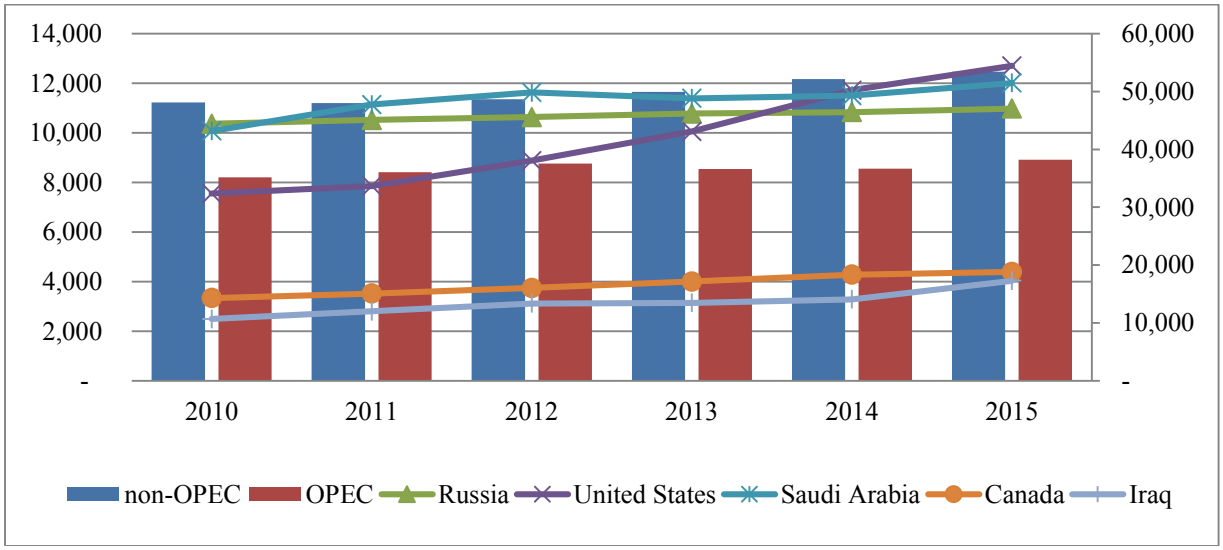
III. Supply

The uneven distribution between oil reserves and its universal consumption determines the immense importance of trade flows between several producing countries and the rest of the world. Some 70 % of oil reserves are located in OPEC countries which were responsible for 44% of global production in 2016. Between years 2010-2015 non-OPEC countries increased its production by 5.3mbd while OPECs countries oil output grew by 3 mbd. This growth came predominantly from 4 countries USA (+5,1mbd) and Canada (+1mbd), in the North America and Saudi Arabia (1,9 mbd) and Iraq (1,5 mbd) in the Middle East and Russia (0,6 mbd). Shale oil in US has becomea major contributor to global oil supply and was the main reason behind US oil production growth. According to IMF (2017) uncertainty surrounding the development of unconventional sources is governed by the very uncertain nature of the processes of innovation and adoption, owing to an interaction between below and aboveground factors. All in all, the rising importance of unconventional sources in global supply is not only changing the dynamic response of production to prices, but also results in more uncertainty over the medium term. Annual oil demand growth, commonly projected at about 1.2 mbd, will be met by unconventional sources over the next few years, mainly through resources under development for deepwater and ultra deep water oil, oil sands, and heavy and extra heavy oil. However, in the absence of shale, depletion forces and the legacy of low investment would start to kick in and push prices up significantly after a few years.

Graph 3: Development of oil supply (mbd)



**OPEC and non-OPEC production on right axis*

Source: BP Statistical Review, 2016

Historically, global investment and operational expenditures in oil have closely followed oil price development. During episodes of dramatic price movements, as in the late 1970's, investment in the oil sector responded promptly. In late 2008 during the global financial crisis, oil investment plummeted but then rebounded in 2009 following the sharp but temporary drop in oil prices. The 2000's episode marks the most unprecedented increase in global capital expenditure and reflects a prolonged era of high oil prices. The rapid increase in oil demand, especially from large emerging market economies, such as China and India, has driven oil prices up and encouraged further investment in tight oil formations, ultra deep water oil, and extra heavy oil, which were previously uneconomical at lower oil prices. While comovement between oil prices and capital expenditure in unconventional sources is akin to what it is in conventional sources, expenditure in unconventional sources embodies technological changes that contribute to changing the response of global oil production. Shale oil requires a lower level of sunk costs than conventional oil, and the lag between initial investment and production is much shorter. Shale oil is thus contributing to shorter and more limited oil price cycles (Arezki and Matsumoto 2016). The unprecedented increase in capital expenditure in unconventional sources in the 2000's meant shale oil production growth has emerged as a major contributor to global supply growth. As we stated earlier, it was the rapid increase in unconventional sources also contributed to the change in OPEC's strategic behavior, leading to the dramatic collapse in oil prices (Arezki and

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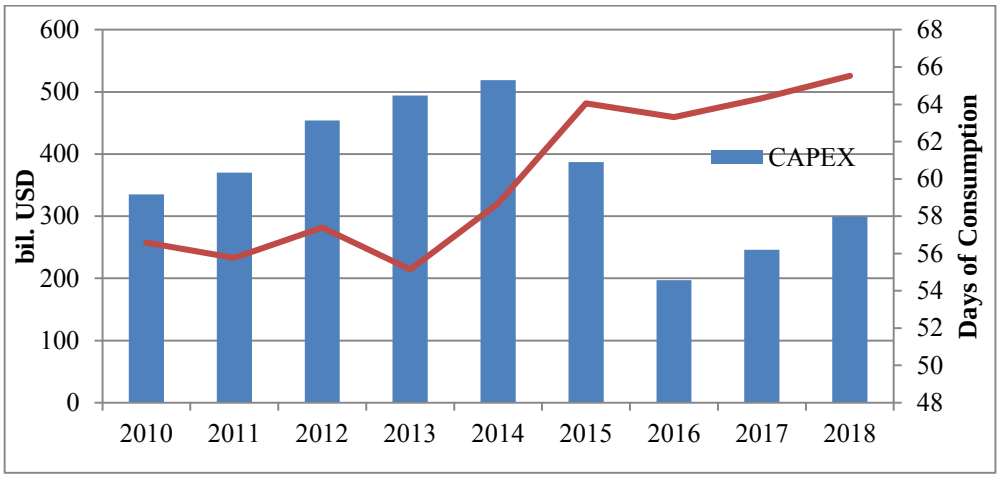
Blanchard 2014). Although that abrupt decline in prices led to a reduction in investment and expenditure, large operational efficiency gains acted as automatic stabilizers. The downward shift in the cost structure induced by lower oil prices is partly temporary. However, the lower investment in exploring new fields is expected to affect production of oil sands down the line.

According to McNally (2016) the adequacy of the supply is the big question for coming years. The current price bust is delaying or cancelling investment in new oil supply that the market may need in a few years but will not have Bloomberg reported that oil companies have cancelled more than 100 USD billion in investments. In January 2016 the energy consultancy Wood Mackenzie estimated that project delays and cancelations since the 2014 oil price bust will diminish oil supply by 1.5 mbd in 2021, rising sharply to 2.9 mbd by 2025. They further warned in July 216 that oil prices at or below 50 USD/bbl will cause most major conventional oil projects get being further delayed or cancelled. In addition to this IEA estimated that oil industry needs to invest about 300 billion USD just to keep supply from declining this is concern especially for producers like Russia, Mexico and China who relies mainly on older oil fields. IEA estimated that an average decline of about 9 %of annual production from mature fields can be expected if the industry does not invest to sustain output. Collapsing investment will translate into less oil supply in the coming five years or so. IEA sees 4.1 mbd being added to global oil supply between 2015 and 2021 down sharply from 11mbd between 2009 and 2015. It is possible that the growth in demand and growth in supply will balance out and the world oil market will settle into a steady price, but it is more likely that current bust in oil prices will be followed by another boom.

Graph 4: Historical and projected oil production CAPEX



Source: Mc Kinsey Energy Insights, 2017

The obvious first physical indicator reflecting on the changing supply demand balance is obviously the state of inventories. It provides the clear image of the long term supply demand balance. According to Stahl-Calsen (2016) it is a very useful tool for predicting the price of oil since too excessive stocks restrain process from rising, while low inventories facilitate price appreciation. For years, oil inventories remained in a relatively stable range. However in late November 2014,after OPEC gave up on its role of swing producer and chose to embark on the new strategy focused on maximizing production and market share of world supply. After this meeting OPECs production increased by 1.1 mbd, which has more than offset declines of production from countries experiencing price driven supply challenges. Overall this excess production caused OECD inventories to increase by 10.5 % to 64 days of consumption, which explains the decision of OPEC to start active supply management on its side in.

IV. Recent Development

The OPECs agreement from November 2016, to cut crude oil output to 32.5mbd, effective January 2017 and for duration of six months was aimed at lowering the OECD stocks as a primary indicator of supply-demand balance. The agreement cut 1.2 mbd from production levels in October 2016. Saudi Arabia bore the largest burden while Libya and Nigeria were being exempted from the agreement. Participants at an OPEC and non-OPEC meeting inVienna on December 10, 2016, agreed to additional cuts amounting to about 0.6 mbd. Russia, a country that is not a member of OPEC, has committed to reducing production by 0.3 mbd, and 10 other non-OPEC countries agreed to contribute the remainder. Following these production agreements, Saudi Arabia indicated it could cut production beyond its initial commitment in a bid to enhance the credibility of the agreement. In response to these agreements, spot oil

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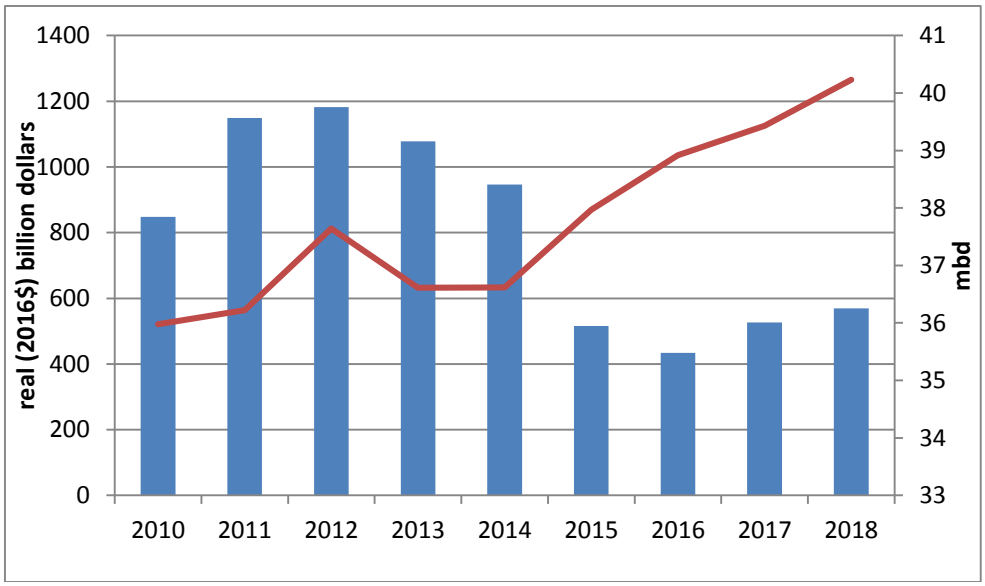
prices increased to more than $50 a barrel. That price of oil move stimulated investment, which is expected to increase in 2017 after two consecutive years of significant decline2.The effectiveness of the production agreements could thus be partially offset by an increase in U.S. shale oil production, which, unlike conventional oil, can commence within a year of initial investment. Production data from the International Energy Agency (IEA) for January 2017 indicate that only a few OPEC members fully complied with the agreement, although Saudi Arabia has cut more than initially agreed on and the overall compliance reached according to some sources above 100 %. Despite that, as we have shown above the oil prices kept range about between 48-55 USD/bbl, as market participants perception of the state of oversupply did not change dramatically, which is understandable considering the growing production from regions like US (shale oil) and Libya or Nigeria, which were not participants of the original deal due to then on-going violent unrests. The second factor watched by oil traders was the level of OECD oil stocks. Those did not register any significant draw downs, partially due to the fact, that OPEC oil production cut, said nothing about the exports which lead some OPEC members to increase its exports using their reserves and higher production at the end of 2016 before the agreement came into force. This setup of the oil market forced original agreement being extended for another 9 months till the end of the first quarter of 2018 during another meeting in Wien on 25.5.2016. The immediate response was quite counterintuitive as the price of oil futures lost over 2.7 USD/bbl on that day and continued losing ground since then trading around 48 USD/bbl at the beginning of June 2017. A case can be made why oil market participants expected deeper cuts or longer extension of the agreement, although the fact is that primary goal of OPECto increase its revenues was achieved as at the beginning of 2017 increased it reportedly increased by 17 %. This came after 4 years of continuous declines in revenues which have gone down by almost 700 bilion USD/year from 2012's 1131 bilions USD/year to 433bilions USD/year despite production growth of almost 3 mbd during that period.

2It needs to be noted that upstream investment has not fallen for two consecutive years since 1986.

Graph 5: OPEC oil revenues & production



Source: EIA, Short Term Energy Outlook (May, 2017)

In order to compensate for this drop countries started using their wealth funds. Four of the world'slargest SWFs are based in oil producing countries. Between March 2015 and March 2017, the collective assets over seen by sovereign wealth funds (SWF) decreased by 0.5 %. That compares with the 14 per cent increase in the two years to March 2015, according to the Sovereign Wealth Fund Institute. Governments in Norway, Saudi Arabia and Kazakhstan are among those that turned to state backed funds to help stemrevenuelossesas the oil price fell. (FT,2017) and in the two years to the end of 2016, SWF with drewat least 85billion USD. This meant, the assets managed by state back edvehicles that owe their origin to oil and gas fell 1.5 % over the past two years, compared with growth of about 0.7 % for non-oil or gas-related funds.

V. Conclusion

The oil market has proved its cyclical nature once again in recent years. After several years with price hovering above 100 USD/bbl, increased investments have enabled the supply to catch up with demand which together with overestimated demand led to supply glut

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and slump in the prices at the end of 2014. Almost two years of oil price being at or below 50 USD almost halted the shale oil development in US, which consequentially have led to hint of slight drawdown of oil inventories in 2016 suggesting the return of more balanced oil market. However, the low oil prices did not weight only on shale producers in US. OPEC countries which state budgets heavily relies on revenue streams from oil exports were hit as well. As we documented above, the steep decline in their incomes, were balanced through their wealth funds. We believe that OPEC countries were trying to speed up the process of supply-demand rebalancing of the oil market in order to boost their revenues, but their effort supply management backfired as their initial supply cut helped shale producers much more than they expected. During the previous two years of low oil prices, shale companies were able to streamline their operation and price boost they received from OPEC action tipped oil market back to the state of oversupply, as development of oil reserves in 2017 shows. This left OPEC countries no other choice but to extend their supply cuts in May 2017 as the other option was another protracted period of even lower prices. The trajectory of the oil price for the rest of 2017 and 2018 remains unclear. The investment banks have repeatedly adjusted their price forecasts downwards and IEA (2017) have recently predicted that oversupply will prevail in 2018 as supply in non-OPEC countries is predicted to rise by 1.5 mbd and outstrip the demand which should reach 100 mbd first time ever. On the other hand, the growth of shale oil production is not certain at all. The American shale producers face rising drilling costs as the oil rigs usage have been raising in recent months. Furthermore, as Reuters (2017) recently reported unlike 2016 shale producers in expectance of higher oil prices did not hedge their production this time, which could halt the projected fast shale development. To add even more doubts to OPEC situation, rising production of Libya and Nigeria, or geopolitical tensions might undermine the validity of the OPECs cut extension.

Either way, taking into account longer period of low oil prices necessarily coupled with the low investment into exploration and production will inevitably lead to reiteration of another boom cycle as demand is unlikely to decline fast enough to prevent repeating this scenario.

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