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Unconventional and Conventional Oil Production Impacts on Oil Price: Lessons Learnt with Glance to the Future

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Abstract

Energy is not a traditional commodity where low prices is always good news! It might be good for some, but definitely, not the case for many. Energy resources including, fossil fuels and renewables, have a significant impact on our day to day activities and they have been prime contributors to our lives retention, advancements and upheaval of the world economy at large. As a result, oil has not only played the role of the master commodity on a financial and economical level, but has also extended its supreme impact to the social, sociopolitical and geopolitical aspects of the modern world. However, it is peculiar to note that even with this significance, the oil industry has been experiencing various economic shocks over the past decades. Such shocks have directly been reflected in oil price fluctuations within a dynamic and short timeframe. With the OPEC and non-OPEC production fluctuations against consistent economic growth, worldwide geopolitical conflicts and the ongoing competition between conventional and unconventional oil reserves, the swings in oil prices have become a phenomenon which is worth understanding and analyzing in order to prospect its future trends on the long run. The key question to examine is whether the recently experienced battle between production rate and oil prices will continue affecting the global market over the coming years. This study explores various factors formulating the volatile behavior of oil prices and links the contemporary situations to the historical oil price spikes and trends related to specific events that we know and several others hidden beneath.

One of the main key drives for the current oil crisis is presumed to be the active production of unconventional oil which poses a significant threat to conventional oil producers and has extended its impact to both political and economic levels. Furthermore, the future of conventional oil reserves is analyzed in depth based on generated empirical models prospecting the future profiles of various extractable ultimate recoverable (EUR) scenarios while considering external factors such as socio-political and economic growth. The decline rate of conventional oil reserves productivity is expected to be prominent over the next decades as depicted by this study. This further supports our conclusion that the current positive supply oil price shock and the active emergence of unconventional oil will lead to a disruption in the future reliance and usage of conventional oil.

Keywords: Oil; Low prices; Global growth; Investment; Oil price spikes; Economic growth

Introduction

The Oil & Gas Industry is in a volatile place at present. Rather, it has been in such a state for the past few years. The price of crude oil has been on the decline since July 2014 and the price of Brent crude closed as low as $26.21 on the 11th of February 2016. This was the lowest point since 2003 and this has brought out multiple complications over the past few years. In addition to its contribution to the financial market woes, the revenue gap of oil sellers continues to plunge while some are struggling to continue their ongoing production. This has not only raised concerns of bankruptcies but has caused a lot of discomfort among investors about global growth. This leads to a critical question: Where we, currently, stand and where we go from here?

During one of the most historic meetings of 2016, Organization of Petroleum Exporting Countries (OPEC) and its members agreed to limit oil production for the first time since 2008. However, as per the Oil Market Report (July 2017), The International Energy Agency (IEA) reports the failure of OPEC to comply with the limits they had agreed upon. It is reported that in June 2017, the output increased by an additional 340,000 barrels per day setting the highest extraction rate for that year with an estimated total of 32.6 million barrels per day. The IEA also estimates a surge in global oil demand growth in 2017 by about 100,000 barrels a day. This puts the total to 1.4 million a day! Even so, the IEA has warned that this progress is threatened as a result of OPEC's rising output. This threat is even apparent without taking into consideration of geo-political complications. The current decision from the OPEC countries and its members to curb oil output is expected to last till March 2018. However, as of September 2017, their effort has been partly negated as countries such as Libya and Nigeria, who were exempted, from the agreement has produced more than estimated while other members did not achieve the targeted cutbacks. This also led to a short-term price gain that assisted in a surge of unconventional oil exploration and production activities in the United States.

Advancements in market efficiencies also play a role in the persistent downward trend of oil prices. With the current market conditions and the fluctuations in oil prices, it has become apparent that investors have put multiple long-term ambitious projects on hold in favor of those with near favorable Return on Investment [1-3]. Unconventional oil projects, again, in the United States is a prime example for this scenario. When OPEC and other members agreed to cut back on 1.8 million barrels a day of output from the market, the oil prices have been less volatile as compared to the previous years. And this has put shale drilling on an advantage as they have become increasingly profitable and efficient over time. Neil Atkinson, head of the IEA's

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oil markets and industry division has an apt description on why he believes the current market price is self-capped. In one of his interviews on Bloomberg, he mentions 'The resilience of the US unconventional shale producers and the flexibility, the ability to bring on more oil at relatively low cost and short notice, means any signs of life -- as far as the price is concerned -- encourages more US unconventional shale. Investigation of Drilling Productivity Report for the past few months further validates his point. In addition to significant rise in production of Oil and Gas, the rig count has significantly gone up each month. But before we further dive into the complexities we are dealing with, let's consider the fundamentals for further analyses.

The Infamous Cycle: Supply and Demand

Any economist can introduce you to the infamous supply and demand cycle. In brief, it talks about the price of a product (P) which is determined by a balance between production at each price (supply S) and the preference of those who wishes to purchase at a particular price (demand D). A positive shift in demand may change results in an increase in price and quantity (Q) of the product that is sold depending on the given trend of supply. In simple terms, if there is a shortage of an existing product, the prices rise and satisfactory substitutes become temporary solutions. However, if there is a surplus of products, prices crash, which leads to significant consequences to higher-end producers and small suppliers. Even though this may be considered as a general representation to the cycle, it is inadequate for comparison with the current realities of the Oil and Gas industry. Supply and demand are quite inelastic when it comes to the experienced fluctuations in the oil price. Oil price fluctuations are generated from a highly complex phenomenon involving several unpredictable parameters other than the simple supply and demand game. Hence, a deeper outlook is necessary before we evaluate anything further.

Do We Really Need the Oil?

As seen since late 2014, the major players in the industry did not drop out but instead tried to make up by increasing the volume of output. Wishful thinking of making significant profits once there is a near term increase in oil price along with a string of other complicated factors landed us in the current state we are today. If we are to investigate this further, on the supply side we have noticed a significant push on technology and efficiency for more expensive unconventional oil as we were exhausting our conventional, easy and cheap to extract oil fields. Furthermore, high prices can justify re-entry into partially depleted wells with the help of additional recovery methods to extract more oil if it is economically viable. Hence, we realize that supply is not the major concern but demand as it is less certain.

Figure 1 shows a graphical representation of the world oil demand from the second quarter of 2013 to the first quarter of 2017 as per the data released by the IEA. It is evident that the demand for oil has significantly risen over the years. If we are to investigate further, we find that as per the data from IEA, one of the major contributors to oil demand is transportation. This is estimated to be more than half of the total oil demand, which amounts to around 52 million barrels of oil per day. It is also reported that the demand in transportation has grown significantly since 2000 and has contributed 80% to total global oil demand growth between 2000 and 2015. In comparison with the second largest contributor – the industry sector, the demand, which includes feedstocks, is just 17 million barrels of oil per day. To further justify this, Alforgi explains that an increased number of automobile transportation requirements led to the consistent demand for oil in areas such as China, South East Asia and Eastern Europe. It is reported that transportation occupies 48% of the total utilization of oil. This is expected to reach a worldwide increase from 40 million barrels per day to 48 million barrels per day by year 2019 [4].

Other supporting factors also links to population growth, requirement for electricity generation from oil as an energy source as well as associated needs for residential accommodation and public facilities [4]. It is also reported that increased oil demand is strongly linked to the continuous to rising economic growth. This is also linked to geography and the different population among the countries [5]. Economic growth is linked to population growth and this advances in parallel with human lifestyle. Hence, it might be quite surprising to know that the country's standard of living affects the socioeconomic behavior of the market since a more sophisticated life dictates higher energy consumption and hence demand on oil and gas becomes higher [4]. The percentage utilization of oil as a commodity is an important factor for this study.

Historical Battles and the Emergence of Heavy Oil

History has shown that oil price is mostly politically driven rather

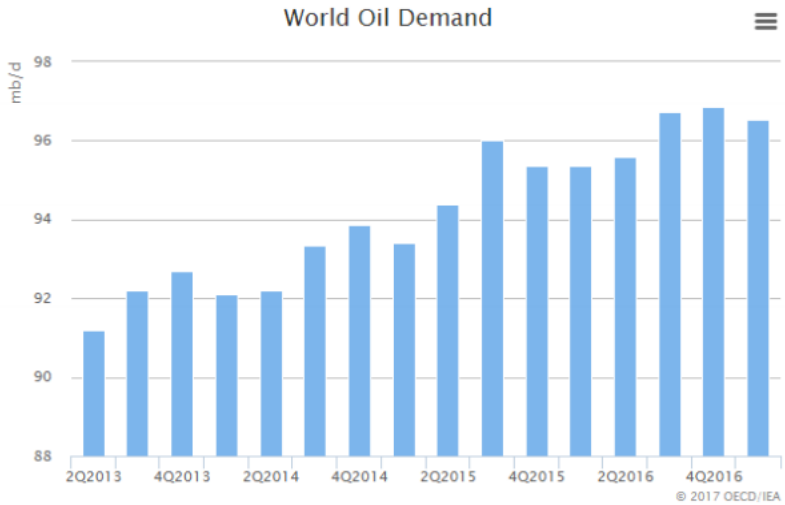

Figure 1: Graphical representation of world oil demand [IEA, Q2 2017].

than only linked to supply and demand changes. In fact, political insecurities created revolutionary incentives for various countries and non-OPEC ones specifically to hustle for securing their energy demands and achieve economic independence. In general terms, wars and political crisis have led to the interruption of the processing facilities and producing reservoirs due to shutdowns along with the high oil demand rate causes the eventual increase in oil price as oil resources are scarce. Figure 2 below provides the chain of historical events and their associated oil price disturbances.

History shows that the 1973 oil crisis led to a long term worldwide economic recession and is considered as a 'negative supply shock' since the reduction in oil supply caused skyrocketed increase in oil price. In fact, this crisis was inspirational to several countries to adapt new strategies to seek economic independence from external OPEC controlling power of oil price.

Accordingly, this crisis created incentives for the US and other non-OPEC countries to invest more efforts in exploring unconventional oil reserves and other alternative energy resources such as solar and wind energy. Although the US intended to boost its production of domestic heavy oil during the 1973 crisis, however, due to excessive US demand rate at that time and due to the bad financial status, high production cost of heavy oil at that time could not be financed. As a mean of achieving economic independence and in addition to the establishment of the Energy Policy and Conservation Act (EPCA) in 1975, the International energy agency was established in 1993 for the purpose of keeping track of the oil supply rates and associated price.

The temporary 'negative supply oil shock' generated from the oil weapon used in 1973 alerted the US and other western countries to initiate research and development work for exploring unconventional reserves. Hence, the first initiatives to discover new oil resources was the first trial of shale oil reserve development carried out by George Mitchell and Tom Ward in the 1980s as well as the first large-scale production of oil shale started by the Devon Energy company in the beginning of the 2000s [6]. These were the first steps of an era of a 'technology shock' and a 'positive supply shock' formulating the commodity of unconventional oil. As a result of discovering advanced technologies, unconventional oil development increased the supply of oil in the market. This means that it is undeniably true that the temporary 'negative supply shock' in 1973 has actually opened the door for the emerging of a long term 'positive supply shock' experienced at present. Additionally, with shale oil reserves being accessible and under active production, a contingency plan is created for accommodating the country's energy demand in case of any possible future oil shock created due to political conflicts. This guarantees the resilience of the American economy and strengthens its financial structure.

The current 'positive supply shock' of unconventional oil being pumped into the market has led to a decline in oil prices and fired a competitive battle between conventional and unconventional reserves. OPEC as a conventional oil producer is currently facing a challenging position due to the continuous supply of shale oil by the US and Canada irrespective to its high production costs. Currently active shale oil production doesn't only fulfill economic, financial and political independence from OPECs power but can also exercise political pressures on giant conventional oil producing militarily powerful countries such as Russia. The US shale oil production distracts Russia in the energy market and tends to affect its global power on the long run. These are examples of utilizing unconventional reserves as possible political and financial weapon for the second time. The first oil weapon used by OAPEC in 1973 was reversed in direction and reflected the current second oil weapon of unconventional oil fighting against conventional oil reserves.

Both of the past and the current battles share similar targets of fulfilling political and financial security goals, however, it is evident that one of them actually created the other. However, in both cases, the continuity of producing from conventional or unconventional all depends on the investment business decisions and the alignment between the economic consumption demand generated from economic growth as well as the balance between the ability of producing companies to satisfy their domestic needs along fulfilling their market financial targets. This dilemma is similar to the relation between excessive consumption of (increased past demands) leading to environmental and climate issues which consequently then caused disturbances in oil price as a result of supply disruptions. The negative supply shock back in 1973 leading to rising in oil price retarded economic activity while the current positive supply shock is stimulating the economy of the producers of unconventional oil while retarding the economy of the conventional oil producers.

The skyrocket increase in oil prices due to negative supply shocks encouraged investments as oil price is high and eventually has weakened the value of 'easy money' with a consequent reduction in the demand. This by itself has caused a reverse effect of market collapse of low oil prices due to the reduction in demand. This dilemma goes in a cycle where every extreme scenario would lead to the opposite extreme scenario over time.

OPEC Versus Non-OPEC Strategies

Organization of the Petroleum Exporting Countries (OPEC) had a significant contribution in governing the oil price around the world by regulating their production rates [6,7]. OPEC which used to represent the oil cartel, have been considered the 'controlling master' of oil prices

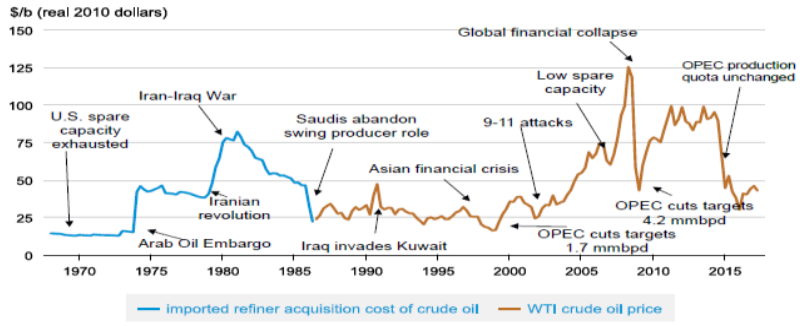

Figure 2: Crude oil Prices and key geopolitical and economic events [US, EIA].

as they have been contributing to more than 40% of the total global oil supply [8]. Accordingly, OPEC has been playing the main role in regulating the oil supply in order to maintain oil prices as stable as possible while meeting its financial, economic and even political goals. Figure 3A illustrates the effect of OPEC's changes on the OPEC basket oil price. OPEC's strategy in setting worldwide oil prices by regulating its supply was targeting two main key goals: maximizing the revenue of its members by setting the oil supply to provide profitable revenue and secondly, the extent of supply manipulation shall ensure that oil prices were not high such that other conventional oil substitutes would become appealing to worldwide customers.

On the other hand, Non-OPEC producers which contributes to 56% of the world's oil production also witnessed a decline in year 2016 as seen in Figure 3B with a rate of 0.8 MBOPD which is the largest decline in 25 years. In fact, the production of US tight oil fell by 0.3 MBOPD in comparison to the remarkable growth in 2016 [5].

Low oil prices in 2016 have de-accelerated the activity of unconventional non-OPEC production in addition to a reduction in its rate. Their strategy targets developing the IOCs and maximize their investment rather than exercising power over oil price regulation like OPEC. In case their production falls due to any reason, oil prices would increase and would put the pressure on OPEC to interfere to re-adjust the market while the non-OPEC will re-adjust accordingly.

Non-OPEC reserves are mainly attributed to high production costs as most of them are of unconventional nature such as deep water reserves and shale sands [5]. Considering technological advancements in the exploration and production of unconventional oil by non-OPEC countries such as Canada and the US, non-OPEC's oil pumping in the market will give rise to a stronger competition with OPEC and which will indirectly reflect in the volatility of oil price. The forecasted non-OPEC oil supply produced by IEA indicates that the rise in the non-OPEC oil supply beyond year 2017 gives a sign of the consistent pressure imposed on OPEC to continuously maintaining their political and economic balance by controlling oil price. Accordingly, it is suggested if OPEC have never owned the concept of spare production, market would have stabilized naturally by the 'actual' delivered production by OPEC and non-OPEC countries. This means that the battle between OPEC and non-OPEC and the consequent oil price fluctuations will continue as long as the concept of spare capacity prevails [5]. When OPEC spare capacity diminishes, the market game of supply/demand will re-establish an equilibrium oil price.

In addition, this verifies that geographical distribution of reserves and their associated producers affect the relation of the extent of supply to the oil price. This geographical factor is in fact a geopolitical factor. For example, non-OPEC markets such as Russia, India and Brazil have introduced new sources of supply and created threats to the OPEC producing countries which has led to a noticeable reduction in oil prices [9]. Russia is a superpower country owning one of the strongest military infrastructure in the world and producing around 10.5 million barrels per day by year 2015 [10]. This political and economic power encourages Russia to stick to its independence from OPEC's authority in controlling oil prices in the market. In fact, Russia's main goals is to maximize its revenues from selling its crude despite the ongoing American attempts to shake Russia's political strength in the region. On the other hand, examining the political effects on oil prices and considering one of the largest oil producers around the world like Saudi Arabia, such a giant OPEC member can strongly manipulate oil prices by increasing or cutting down its production. Figure 4 shows the dramatic shift of crude oil price with respect to changes in Saudi

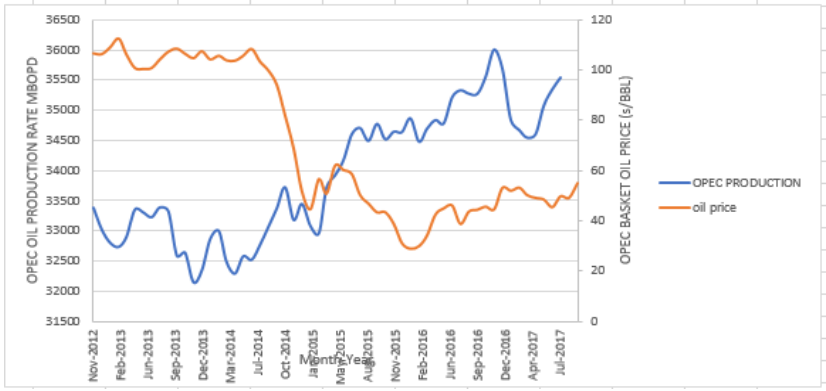

Figure 3A: OPEC production historical trend and rising oil prices between 2003 and 2008 [US EIA].

Figure 3B: Non-OPEC production historical trend and rising oil prices between 2003 to 2008 [US EIA].

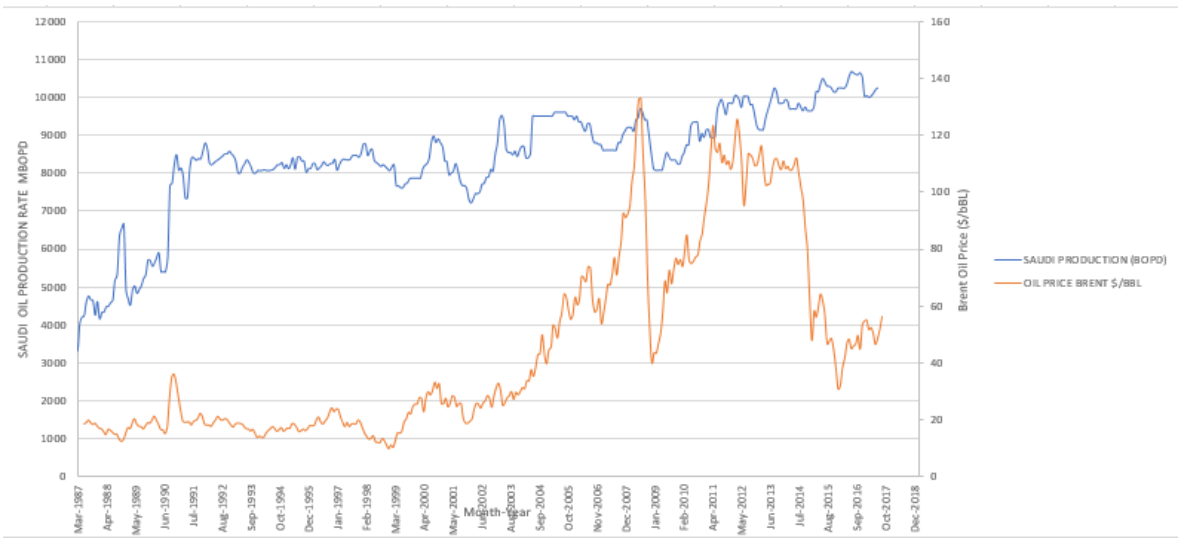

Figure 4: Variation of crude oil price with respect to Saudi productions [US EIA].

production, although the contrary was expected that price would fall as supply rises. This shows how Saudi crude dominates the market such that prices almost move in tandem with its production rates. This behavior is in agreement with the economic-scenario model developed by Hadi et al. which states that oil production increase in South America would lead to reduction in oil prices while increase in oil production in other areas lead to an increase in oil price [3]. However, such a behavior was defeated from 2015 to 2017 due to the above explained development of competitive unconventional reservoirs.

Referring to the most recent historical profile of energy resources production in each of the US, Russia and Saudi Arabia, we notice that despite the reduction of WTI crude price, shale oil and gas development in the US enabled it to increase its petroleum production in 2015 by 1 million barrels per day and contributing to a total of 60% of the world's energy production.

Russia on the other hand had its petroleum production increasing only by 0.1 million barrels per day due to the economic challenges experienced by the conventional reserves versus shale oil production in addition to the unfavorable climate conditions. Saudi Arabia retained its petroleum supply to a constant level despite the decline in oil prices and the emergence of the US shale oil production [10].

Accordingly, with the help of the unconventional oil revolution, it took the US less than 3 years to become a leading country in the global petroleum and natural gas supply.

Battle Between Conventional And Unconventional Oil

The past decade has been experiencing a diversity on the type of oil reserves being produced. Conventional reserves which have been produced for hundreds of years is currently facing a strong market competitor which is the unconventional oil. While conventional oil is inherently geologically recoverable using traditional drilling techniques, unconventional oil requires intensive efforts to extract due to its geological complexities. Figure 5 shows the relative increase in unconventional oil production activities through the past two decades and how it has influenced the contributions of the other players. It is evident that conventional oil production peaked in January 2011 at 86.2 MMBPD (Figure 5) and non-OPEC conventional production peaked in November 2010 at 49.8 MMBPD (Figure 5). It was also reported that the average unconventional oil daily production of 95.5 MMBPD for 2015 exceeds EIA's Annual Energy Outlook 2015 forecast (April 2015) by 2.6 MMBPD [5].

This abrupt and unexpected market behavior indicate a sign of the power of unconventional oil and its rising prosperity over time. Thanks to technological advancements, such oil reserves have been experiencing exploration and extraction advancement, yet still passing through processing difficulties due to its compositional complexities. Hence, as technology develops, producers tend to pump oil in the market which would consequently lead to less oil price. A clear example of this phenomenon is the US shale oil production. Unconventional reserves are mainly explored in various forms: shale oil in the US, heavy oil in Venezuela and oil sands in Canada. Development of unconventional reserves have led to a revolution in the oil industry and has affected OPECs business strategies. This is in agreement with the predictions of Leo et al. [11].

The ongoing development of Shale oil reserves in the United States especially in Texas North Dakota using new hydraulic fracturing techniques has created a challenging threat to OPEC. In fact, the US which was relying on crude oil imports from OPEC countries is now fulfilling 84% of its total energy demand with unconventional oil. It is worth mentioning that unconventional reserves are not only American, they are also located in China, India, Russia and Canada [5].

Despite the fact of the current ongoing unconventional reserves production in the United States, the US has not given up its needs to import crude oil from conventional worldwide producers such as Iraq Nigeria and Saudi Arabia.

OPEC's contribution to the US's imports is around 40% which is quite close to the Canadian supply of heavy oil that stands around 41% of the total US imports. However, OPEC's supply to the US reached its lowest rate in 2016 since 1973 (Figure 6). The US import from Saudi Arabia has increased from 2015 to 2016 by a factor of around 45%. Similarly, the contribution of Iraq's and Nigerian's crude supply to the US's imports also increased between 2015 and 2016 by 182% and 151% respectively (Figure 6) [12].

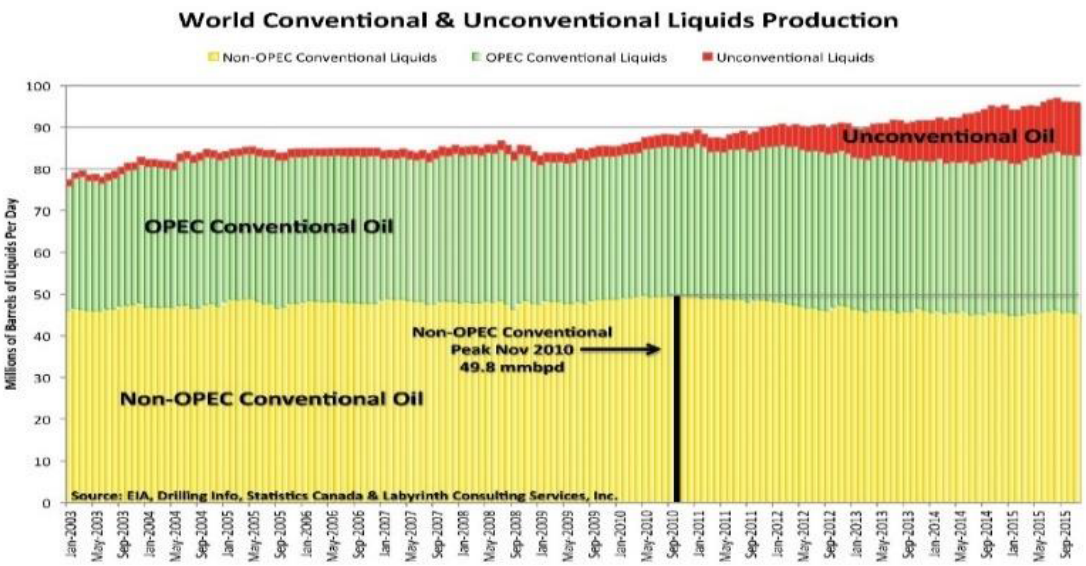

Figure 5: World conventional and unconventional liquid production [US EIA, DrillingInfo].

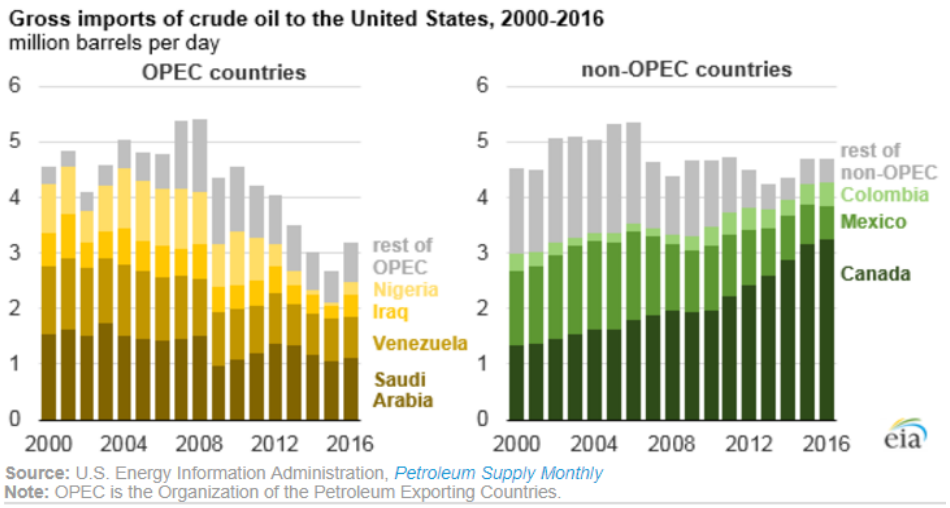

Figure 6: Gross imports of crude oil in the United States [EIA].

The above verify that the US, which has always been the largest imported of crude oil for decades, is still dependent on importing conventional oil from OPEC producers despite the fact that it is simultaneously enhancing the development of unconventional shale oil reserves.

Salameh explained that a non-OPEC oil producer like the US can absorb the consequences of a drop in the price of a West Texas Intermediate (WTI) by 30% for example and would still continue shale oil production as the cost/profit breakeven is still achievable. However, for an OPEC producer like Saudi Arabia, due to the government's commitments to infrastructural building and social welfare projects, such a drop in oil price would lead to adverse economic effects due to the difficulty in achieving the optimum breakeven [12].

From time perspectives, the real question is whether the current oil shock will be sustained over the long terms or will become temporary like the first oil shock. Various arguments arose by economists explain that unconventional oil development will fail to sustain its profitability due to the cost of getting the oil from the reservoirs and hence would not be a permanent threat to conventional reserves.

Salameh has explained that the revolution of the US shale oil production is not as dangerous as it seems. He argues that unconventional oil will not sustainably take over the conventional oil production and that the US as an example of a shale oil producer cannot give up its imports from OPEC [12]. Salameh statistically studied that recoverable US shale oil doesn't represent more than 3% of the oil global supply and hence can't be considered as a major risk to the conventional oil development [12]. The claimed enormous shale oil reserves are nothing but inherent Kerogen which although be recoverable but not economically recoverable. Additionally, the world's economy is mainly dependent on the rate of production of crude oil rather than the estimated resources volume. Hence, due to the high

cost of extraction of unconventional oil, its rate of supply would not be able to compete with conventional oil production over the long run.

It is essentially important to develop an anticipatory and predictive model for realizing the future of conventional oil in the next decades. Will conventional oil still sustain its dominance in the market or would its reserves exhaust over time and lose their productivity? The recently experienced oil crisis of low oil prices makes it unattractive to invest in the oil and gas industry which will then lead to a risk of abandoning conventional reserves for quite long period of time and eventually would leave them in an inactive state threatened with extinction.

In order to answer the key question of whether conventional oil will still dominate in the market, we need to look into accurately developed models providing a prediction for the global conventional production rates. Hallock et al. developed empirical based models for the global and nation wise conventional oil production rates for years between 2002 and 2060. They utilized two main categories of representative light conventional oil: Uppsala-Campbell and USGS- conventional [10].

The structure of this model is based on: economic growth rate and extractable ultimate resource (EUR) which reflects the available reserves. Based on historical empirical data obtained for individual 46 oil producing nations and based on the set assumption of having a decline in oil after reaching 50% of the EUR, the oil production trends are extrapolated and generated for the future time span. Economic growth before the oil peak is considered to be in increasing demand for oil, the decline in oil production after the peak is based on the decline rate of the EUR at the time of the peak. Subsurface factors (geological reservoir characteristics) as well as specific surface factors (above-ground), such as political conflicts, climate changes and wars are all considered in formulating the basis of EUR estimation and its trend of decline post the oil peak. The model considers three phases of conventional oil production profile as well. The nation-wise profiles are benchmarked based on realistic data to project and extend the prediction for the future. Each nation's production forecast was made based on specific assumptions of the available reserves: low EUR, Mid EUR and high EUR. An optimized scenario was generated for the aggregate global oil production forecast and mainly computed from the sum of the individual nation-wise generated oil production models. Such an optimized scenario approach enhanced the matching of the model's predictions with the empirical data. For each of Uppsala-Campbell and USGS- conventional models, the low EUR based models with a maximum annual growth rate of 5% per year for Uppsala-Campbell and maximum 7.5 % growth rate per year for USGS- conventional are shown in Figure 7.

It is worth highlighting that in specific nation-wise model

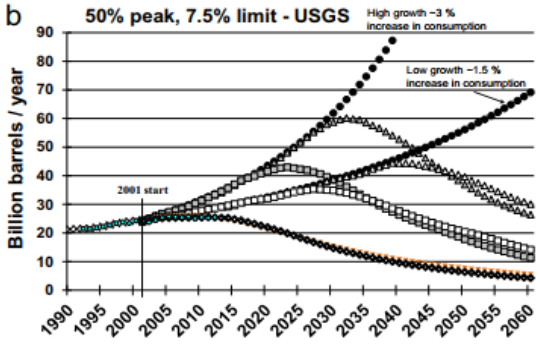

Figure 7: Projection of oil production over the years for optimum models.

prediction, the observed increase in oil production rate was due to the comprimised effect of introducing unconventional resources to the crude oil supply and which could not be excluded from the basis of data used in predictions [10].

The above concluded model's predictions are in contrast to the various claims believing in the powerful future of conventional oil and its sustainability for the next 100 years. Yet, the developed model matching with empirical data from 2002 to 2012 has shown the occurrence of an ''oil peak'' in year 2005 after which conventional oil production rate continued to decline. However, the optimized scenario developed by the model still identifies its limitations in the incapability of predicting the surface crisis which may disrupt the oil production trends further. The role of unconventional oil becomes prominently active due to the disruption factors of the conventional oil production such as OPEC's strategies, wars and conflicts, such unconventional reserves like the Canadian Tar sand and the Venezuelan heavy oil have recently become the 'big sharks' in the market and contributed in compensating for the increased global demand. This means that in order to compensate for the consistent global energy demand, there must be a proportional increase in unconventional reserves with the decrease in conventional oil production [10].

In fact, this model not foresee the positive supply shocks as it was created prior to it. The model which considered that higher oil prices experienced in the preceding years still did not help in improving the production rate of oil and has consistently led to the decline in the EUR as proven by the empirical data. Relating such a justification to the occurrence of the low oil prices in 2015 will evidently mean that conventional oil production decline is going to be even sharper since there are no motivations for investments! Only higher oil prices and technology advancements would help in increasing the amount of recoverable conventional oil reserves. However, that is still too challenging to achieve. As per the empirical data analyzed by the model, in order to catch up with the high growth rate associated with Mid and High EUR assumptions, total global conventional oil production shall increase by 1% per year in addition to a margin of 3-4 MBOPD to cater for aged reservoirs. This means that the cumulative increase in conventional oil production by year 2030 shall be around 100 MBOPD. This is almost impossible to achieve due to the following root causes:

- The predictions made by the model are prior to 2015 and this means that the mandated production increase analyzed by the model are hardly achieved.
- Historical data show that the incremental increase in production from 2003 to 2004 is only 2.6 Million BOPD while from 2005 to 2012 there was a cumulative decline in oil production rate by 0.12 Million BOPD. Such facts discourage the optimistic thoughts of the potential long-term availability of conventional oil.
- Based on the model's perceptions at the time it was developed, it is almost impossible to achieve the required increase of conventional production by 1% per year due to the technological and investment limitations at that time.
- Conventional reserves have been exhaustedly consumed especially due to the large production quotas originally set by the OPEC in the past decades. This determinately affects their availability in future.

The threatening decline in conventional oil which is worsened by political disputes and OPEC's power strategies has opened the door for

the active development of unconventional reserves which, at the time of the model development in 2014, were not as active as they have been since 2015. Looking at the United States shale oil activities, there was an increase in the production from Bakken and Eagle Ford formations by 1.9 Million barrels per day from year 2004 to 2014. The energy information administration (EIA) predicts the large contribution of tight oil in covering the US total energy demand by year 2030 exceeding 6 million barrels of oil per day [5] as shown in the Figure 8.

Technology advancements enabled reaching a total of 4.9 million barrels per day of tight oil production in 2015. This emphasizes the fact that unconventional reserves are capable of supplying a substantially large portion of the global energy demand. While they are being explored and recovered with the help of new technology, and as long as its breakeven price is becoming appreciably low for investors, conventional reserves on the other hand will face a risk of extinction as long as they rely on the natural energy drives of the reservoir and even with the assistance of EOR and IOR. There is no wonder that due to the current relatively easy extraction of conventional oil with the traditional drilling and EOR tools, conventional reserves would be exhausted at some point of time which will then cause a limitation in its future availability. In fact, based on the established 2014 model and with higher expectations of oil production trends in absence of the awareness of the 2015 low oil prices, it was seen that conventional oil reserves will decline in production by 11 million BOPD by year 2020 and 27 Million BOPD by year 2030 [4].

If someone, in 2017, was to ask a prediction of the Oil & Gas Industry for the next 50 years, a probabilistic guess would indicate that most major players would still exist. Even though, companies may differ in size and capacity, current trends are an indication which proves that the extraction of unconventional oil is perfectly viable, at least for the foreseeable future. DNV GL's Energy Transition Outlook (ETO), released in September 2017, also provides a forecast that spans the global energy mix to 2050. As per the DNV GL's Energy Transition Forecast, compared to the 53% of the world energy supply that Oil and Gas accounts for today, by 2050, it is expected to lower to 44%. Gas is expected to be the dominant player from 2035. In addition, it is also predicted that the global demand for energy will also plateau in 2030, followed by a slight and steadily decline over the next two decades due to changes with respect to energy efficiency [13].

Contrary to the old popular belief, the decline of oil prices did not lead to the extinction of unconventional. Instead, it led to technological advancements and efficiency, which caused further price drops based on the market conditions. This surplus production curtailed with weak demand will eventually squeeze out high profile and costly oil activities [14]. The current volatile trend may last a while, but at the same time we need to remind ourselves that neither is it permanent. As a number of factors come into play in this complicated structure, a sharp continuous fall is out of the question. Rather, we expect to see a gradual plateau with a slow but gradual change in the form of energy consumption as reported. Hence, significant new investments along with strict cost efficiency are the need of the hour for future capital and operational expenditure along with operating existing assets sustainably and at optimum conditions. Digitization, automation and strategic innovations in structural, operational and economical model will play a crucial role in contributing to energy security.

Conclusion

The primary objective of this study was to analyze the future of conventional oil and the intrinsic outcome to the repetitive history of oil revolutions which stagnated the market for decades. From the oil crisis of 1973 to the present day, oil and gas prices have been volatile and unstable. The prediction for the same is extremely complicated as the integration of various external factors such as socio-political conditions, economic growth and OPEC strategies have all contributed to this ever-changing nature of crude price.

The active emergence of unconventional oil demonstrated a revolution in achieving energy security in most of its producing countries. Further enhanced by the development of advanced production technologies, conventional oil producers have been facing market competitions especially due to the low oil prices which has been strongly linked to the excess supply of their counterparts. Based on an empirical time-based model developed in 2014 and highlighted in this paper, a prosperous future of conventional oil seems uncertain. In order to cope with the increase in economic growth as well as the forecasted increase in energy consumption, conventional oil reserves needed to be increased by 1% per year. Many may consider this unrealistic as such a growth has not been experienced within the recent decade and in addition to the fact that the current oil prices will deteriorate conventional oil's investment incentives. Current reports indicate that even with the current price and market conditions, unconventional

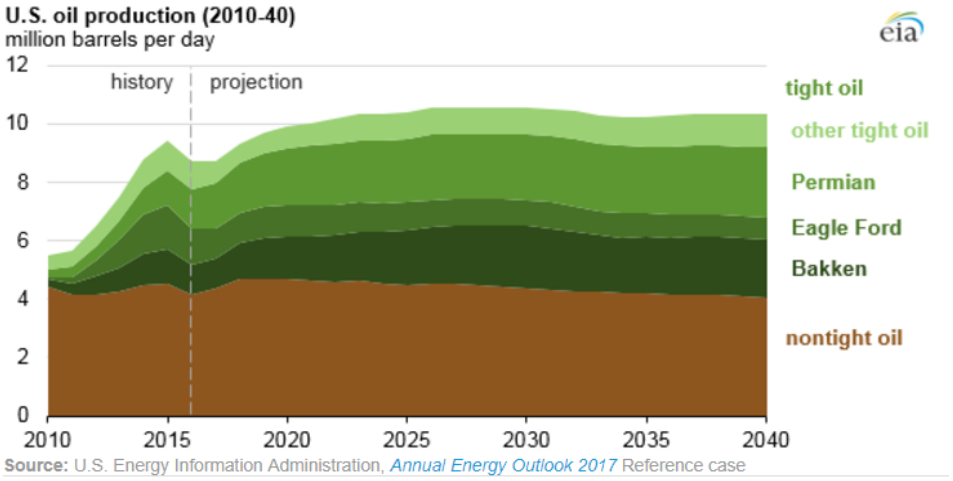

Figure 8: Reported breakeven figures of crude oil [US, EIA 2017].

oil production is still profitable and has been actively taking over the market with future forecasts of being able to supply the total US energy demand by year 2030 and reaching a maximum production of 6 million barrels per day. Aggressive technology advancement due to more R&D investment is and will play a major role in supporting such scenario. And as always with the oil industry, the struggle for survival in the current harsh market conditions will lead to ever evolving advancements to mold our industry tenacious to such unanticipated challenges in the future.

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