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IICEC ENERGY AND CLIMATE RESEARCH PAPER

SUPPLY DYNAMICS AMONG THE "BIG THREE" OIL PRODUCERS: RUSSIA, SAUDI ARABIA AND THE USA

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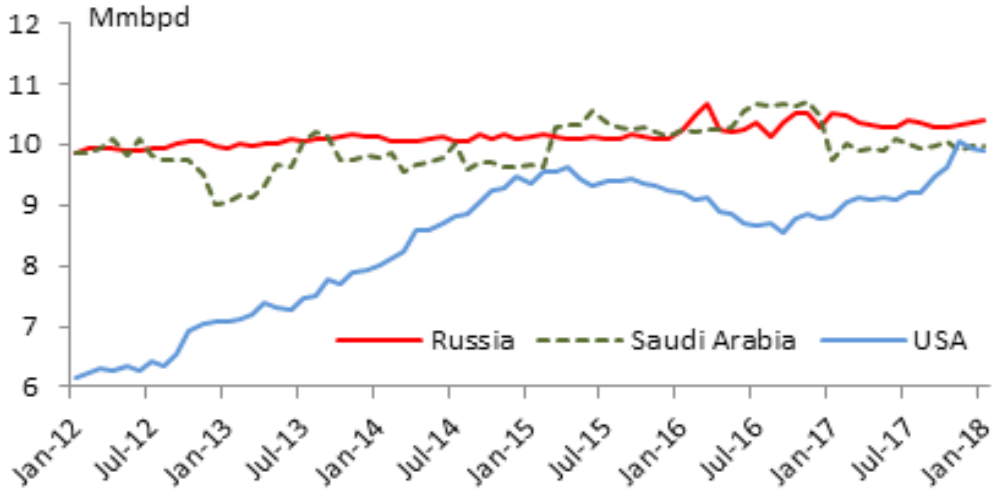
Introduction

The developments of the past five years have represented a live experiment for the global oil markets on an unprecedented scale. They have tested the stress levels of oil-producing nations with respect to the economically viable cost of production, fiscal breakevens, and elasticity of supply under quickly changing market conditions. A new hierarchy of projects has been introduced shifting the focus to shorter-cycle developments. New market fundamentals are turning former net importers into net exporters and have created a new geography of global petroleum trade. The oil matrix has been reloaded and new winners and losers are emerging. The "big three" global oil producers – the United States, Russia, and Saudi Arabia – who, combined, have been producing over one-third of global oil and have been the key oil market players in the twentieth and twenty-first centuries – are in the middle of this process and their actions are going to be key to the future shape of the global oil market. This report focuses on how new oil market developments have changed the oil industries in these three countries, how their strategies have shifted and what these changes mean.

Figure 1: Oil production by the "Big Three"

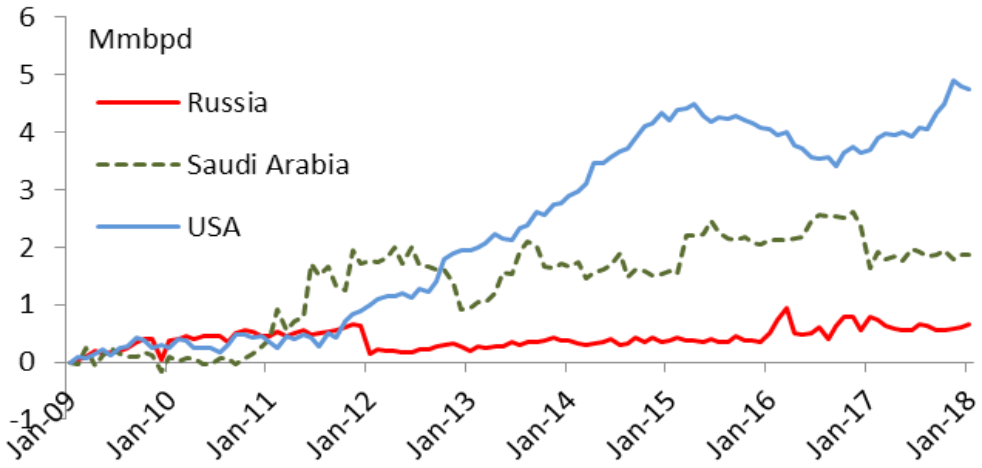


Source: CEPR NRU HSE, JODI data

The Long and Painful Market Rebalancing

The global battle for market share is in full swing on the oil market. During the first phase of the present crisis, the key issue at stake was who was going to assume the role of the market balancer and cut production to remove the record supply surplus. (Fattouh & Economou, Oil Supply Balances: The Four Cycles of the OPEC Oil Output Policy, 2018) For many years Saudi Arabia had acted as the key swing producer within OPEC, adjusting output and reining in other oil cartel members. Until recently it remained indispensable in this role, as no other country could perform this function on the scale required. (Fattouh & Sen, Saudi Arabia Oil Policy: More than Meets the Eye?, 2015) The shale oil phenomenon in the United States has been a game changer. (Dale, The New Economics of Oil, 2015) Cumulative growth in U.S. tight oil production amounted to 4.3 million barrels per day (mmbpd) during 2009-2014, which far exceeded the supply gains from the rest of the world combined. The emergence of a new giant source of crude supply prompted Saudi Arabia and OPEC into starting a war for market share and pushing the balancing burden over to the U.S. oil producers. (Fattouh, Poudineh, & Sen, The Dynamics of the Revenue Maximization–Market Share Trade-Off: Saudi Arabia's Oil Policy in the 2014–2015 Price Fall , 2015) The November 2014 decision by OPEC to not restrict production started the crisis that has been developing for the past four years.

Figure 2: Incremental change in crude oil output



Source: CEPR NRU HSE, JODI data

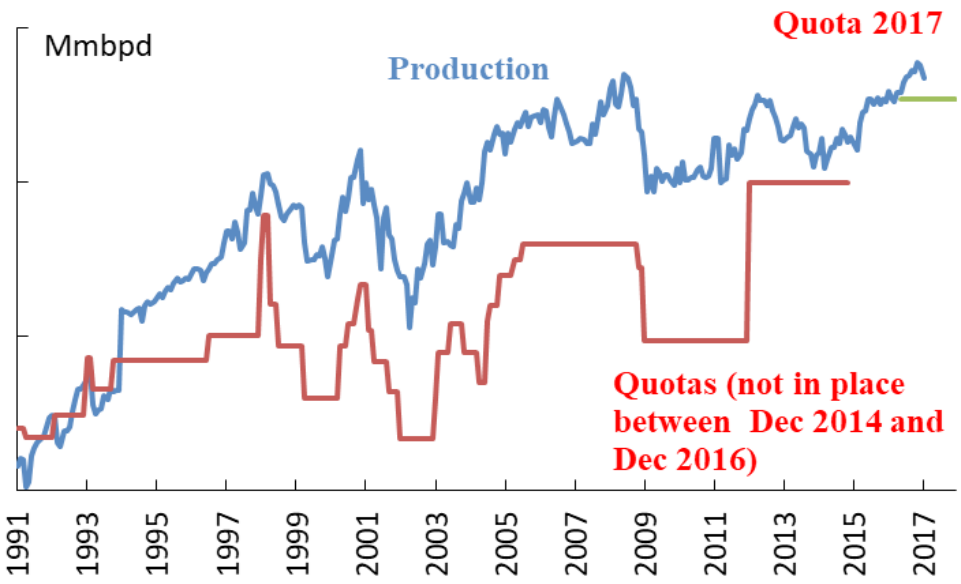
One lesson from the history of warfare is that generals prepare for wars similar to those already fought, not for ones yet to occur. OPEC apparently hoped for a blitzkrieg in November 2014, when it decided not to restrict its output but let market forces do away with the overhang. Unrestrained OPEC production has removed a safety valve from the global oil market and instigated the buildup of excess supply and bearish expectations. (Baffles, 2015) The result was the avalanche that swept over the oil markets and brought down the price of a barrel of crude from $100 in August 2014 to below $30 in January 2016. At the same time, U.S. unconventional oil's resilience to low oil prices has resulted in financial stress on all OPEC producers and has not made the U.S. frackers immediately change course. (Curtis, 2015) In response, Saudi Arabia decided to dig in its heels and wait out the U.S. shale producers until the combined effect of rising oil demand and cuts in high-cost producers' output (including marginal U.S. shale projects) have eroded the current supply overhang. When this happened, OPEC, according to its logic, would regain the ability to influence the market and would be better able to affect prices with much smaller production cuts. (Fattouh, CRUDE AND REFINED PRODUCTS MARKETS: TRANSIENT SHOCK OR SECULAR CHANGE? WORKSHOP, 2014) During 2015 OPEC had had to come to the unpleasant realization that the market fighting moved to trench warfare and was going to result in high casualties for everyone involved. The OPEC strategy meant a slow and painful market rebalancing.

OPEC had to concede that U.S. tight oil producers were proving much more resilient to low oil prices than initially expected. (Bloomberg, 2016) This was partly due to the spectacular technological advance that allowed detailed knowledge of layers and the so-called "sweet spots". U.S. producers have been able to employ high grading tactics with fewer drilling rigs to deliver a greater level of output thanks to a focus on the most prolific sections. Multilaterals have further extended this effect, enabling producers to extract oil with fewer vertical wells but many horizontal extensions from a single well. (Curtis, 2015) Another explanation lies in the symbiosis of tight oil production and the U.S. financial system. U.S. oil producers successfully hedged prices for their output in 1H15 and achieved average prices at levels much higher than prompt market prices. (Reuters, 2015) When the oil price temporarily rebounded to above $60/bbl in May 2015, many of these hedges were renewed, allowing U.S. producers to brave the subsequent price drop to below $40/bbl. (Hamner & Stephens, 2015) The availability of financing and low interest rates also helped. While the test in resolve continued, the market was waiting to see who blinks first.

The ability of U.S. unconventional oil producers to drastically cut costs and employ high grading tactics to outlive the crisis has moved them to the middle of the cost curve and led to a prolonged resilience to low oil prices for them. But the resource base that could be profitably extracted was much less when prices made a deep dive to low $30s per barrel. (Van den Beukel, 2016) As a result, U.S. crude oil production finally started to decline from the level of 9.6 mmbd in April 2015, and the pace of the fall accelerated in 2016, hitting the low of 8.6 mmbd in September 2016. Meanwhile, high-cost producers, including those with Arctic and/or deep-water projects, which have probably taken the heaviest blow from low oil price, were postponing a new generation of projects. (Faucon, 2016) The inertia of these longer-term investments, however, meant that it would take several years to remove the supply overhang.

At this point Saudi Arabia, the key force behind OPEC, decided that it was time to accelerate the rebalancing by limiting supply. (Fattouh, OPEC's Hard Choices, 2017) Markets were skeptical at first, referring to the canonical "prisoner's dilemma" paradox, a case of the lack of trust preventing the collective action that would put producers in a better position as a group. (Merkel, 2016) Any joint initiative on the part of OPEC and other major producers, according to this logic, would not work due to suspicions and absence of a meaningful mechanism to ensure compliance. Even more importantly, for any such deal to work, OPEC would need Russia, the world's largest crude oil producer, to be on board. (Henderson, Room for cynicism and hope in Russia's deal with OPEC, 2016) The prospect of close cooperation between Saudi Arabia and Russia seemed doubtful at first, but difficult times make strange bedfellows. (Henderson & Fattouh, Russia and OPEC: Uneasy Partners, 2016) During 2016 the countries' energy ministers, Khalid Al-Falih and Alexander Novak, had multiple meetings at ministerial level and established a platform to discuss technical cooperation. The deal apparently was based on an understanding that the Saudis would ensure compliance among OPEC members, and Russia would manage the compliance of its oil producing companies, in implementing the agreed production cuts. (Fattouh, Henderson, & Sen, Saudi-Russia Production Accord: The Freeze before the Thaw? , 2016) For OPEC, the deal was less painful than it might seem owing to the fact that the actual production cut necessary to meet the quota was not that great, and most OPEC members save for Saudi Arabia were producing close to their capacity.

Figure 3: OPEC oil production and quotas



Source: World Bank, IEA

On 30 November 2016 OPEC oil producers decided to curb output starting 2017 by 1.2 mmbpd from the levels produced in October 2016, to keep it at 32.5 mmbpd level. It was the first agreed production adjustment by OPEC since 2008. On 10 December 2016 a group of non-OPEC producers led by Russia reached a corollary commitment to reduce production by 0.6 mmbpd (also measured against the levels produced in October 2016). The largest cuts by individual countries came from Saudi Arabia that committed to reducing its output by 0.5 mmbpd and Russia that agreed to production cuts of 0.3 mmbpd.

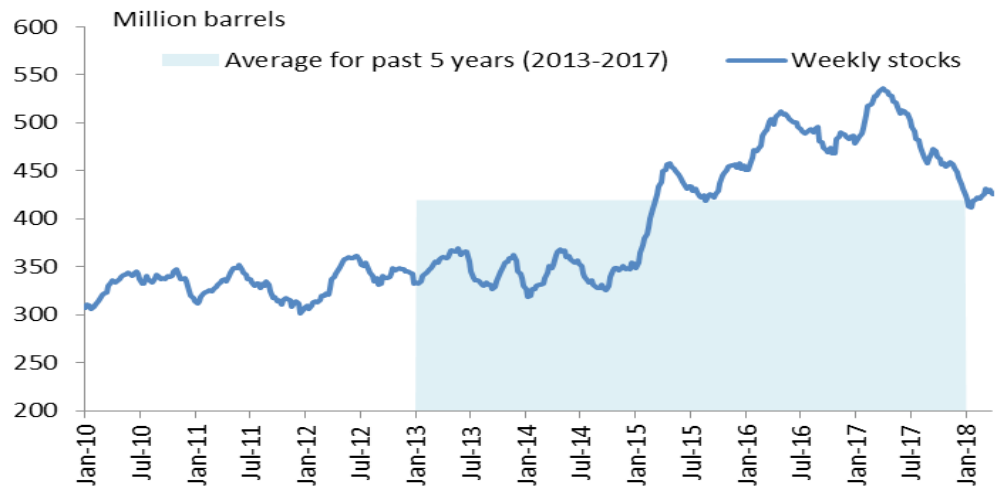
The collective action of the producers was a major shift from a two-year price war towards the return to the managed market. The key goal behind the deal was to start the process of eroding the record levels of crude oil inventories and pushing the futures curve from contango to backwardation. But OPEC+ has also started to develop a vision for longer-term cooperation among producers. As argued by Fattouh:

> "In a world in which many are expecting oil demand to peak in the next few decades, the monetization of oil reserves as quickly as possible is being presented as the only 'rational' policy for low-cost producers, if they are to avoid holding stranded assets or failing to maximize their long term revenues. This scenario, in which producers compete

for market share, is extremely bearish for oil markets both in the long and the short term, as long-term expectations will eventually feed into short-term expectations. By calling for cooperation beyond 2018, Saudi Arabia is charting another route for the market, where OPEC+ permanently plays an active role in managing market balances and participants' expectations and where revenue maximization rather than output maximization is the main guiding principle". (Fattouh, Saudi Arabia: Shifting the Goal Posts, 2018)

During the past 12 months, from March 2017 to March 2018 U.S. crude oil inventories declined by over 100 million barrels and reached the level of 5-year average.

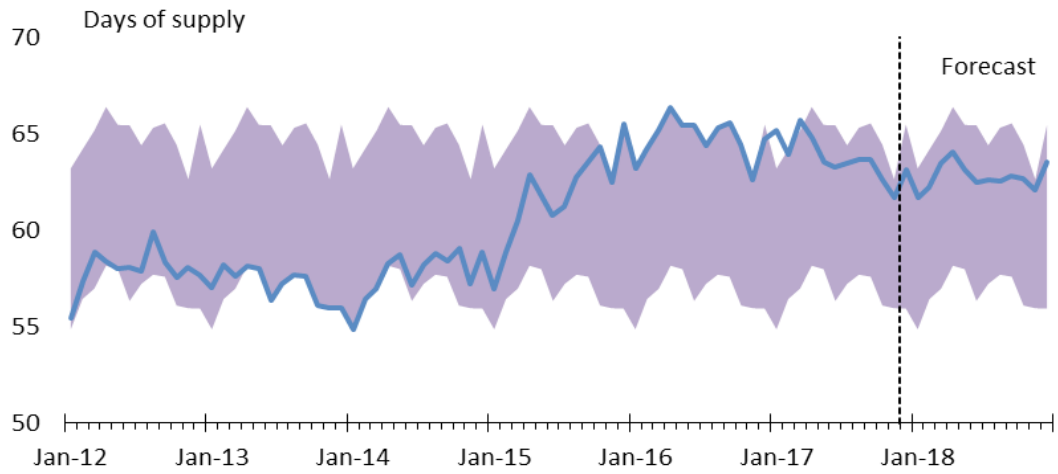
Figure 4: U.S. crude oil stocks excluding SPR



Source: CEPR NRU HSE, data from EIA

OECD commercial stocks of crude and liquids also retreated from historical highs. Expressed in days of "cover", OECD inventories in January 2018 amounted to 61 days, the level of five-year average for 2013-2017, and down from 65 days a year before (Figure 5).

Figure 5: OECD commercial stocks of crude oil and other liquids

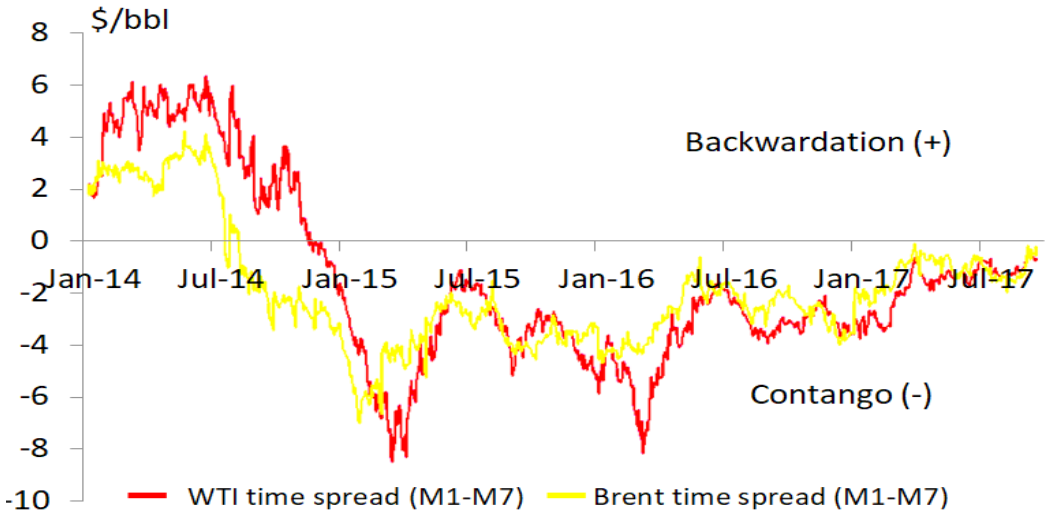


Note: Colored band around days of supply of crude oil and other liquids stocks represents the range between the minimum and maximum from Jan. 2012 - Dec. 2016.

Source: EIA STEO, December 2017

The calendar spreads for futures (the price difference between the nearby contracts and the longer-dated ones) have been gradually moving from contango to backwardation since early 2016 as the oil market has gradually rebalanced. The backwardation of the futures curve is usually associated with declining levels of inventories and indicates the changing balance in the oil market (Figure 6).

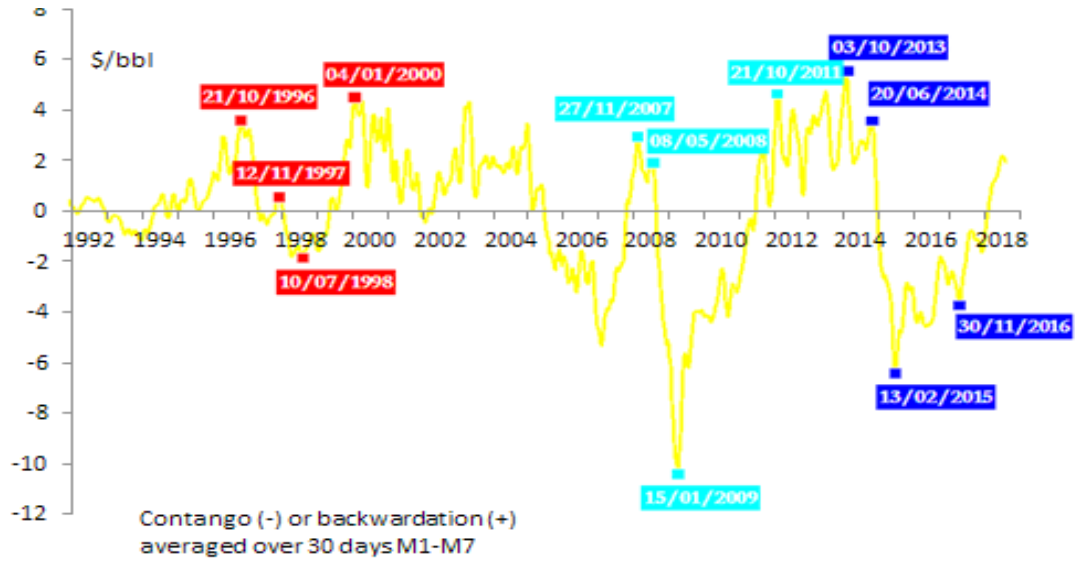
Figure 6: Time spreads for WTI and Brent futures



Source: CEPR NRU HSE, data ThomsonReutersEikon, ICE Futures

At the beginning of 2018 the calendar spreads appeared to peak and start softening, coinciding with a downturn in spot prices, as traders and investors seemed to assume that crude oil and liquids production surge in the United States would exceed the incremental demand increases. But at the beginning of March both spreads and spot prices for crude oil rallied, suggesting the continuation of the market tightening.

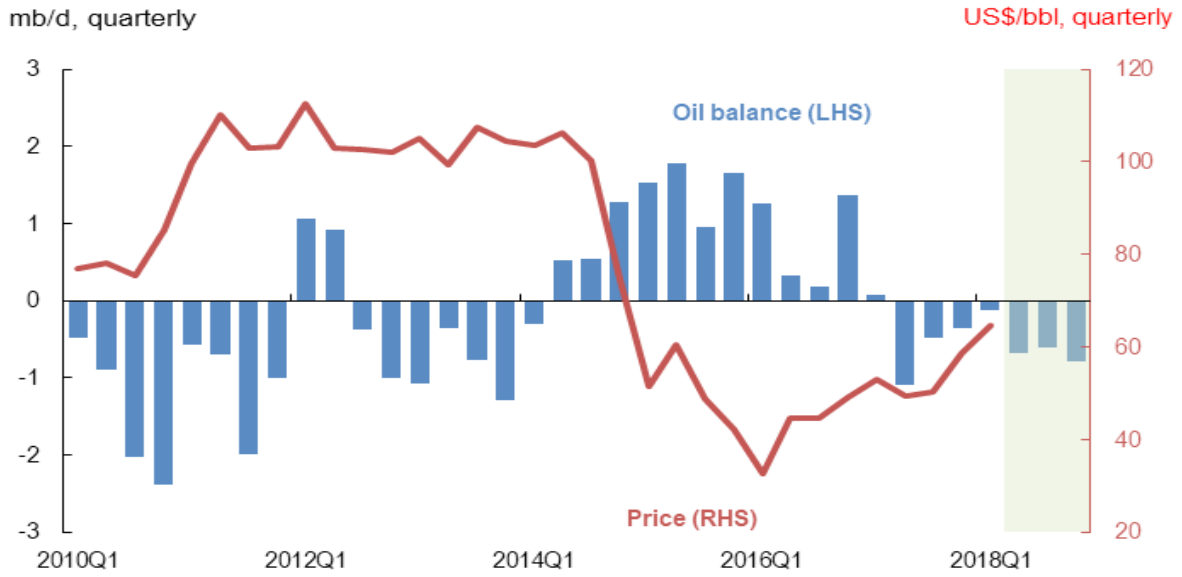
Figure 7: Shape of the futures curve in Brent crude



Source: Thomson Reuters Eikon, ICE Futures@KempEnergy

Declining levels of crude oil stocks and backwardation of the futures curve were the key prerequisites for global oil market rebalancing and price recovery. OPEC has been closely watching these signposts, as the organization was formulating its market strategy.

Figure 8: World oil balance and oil price



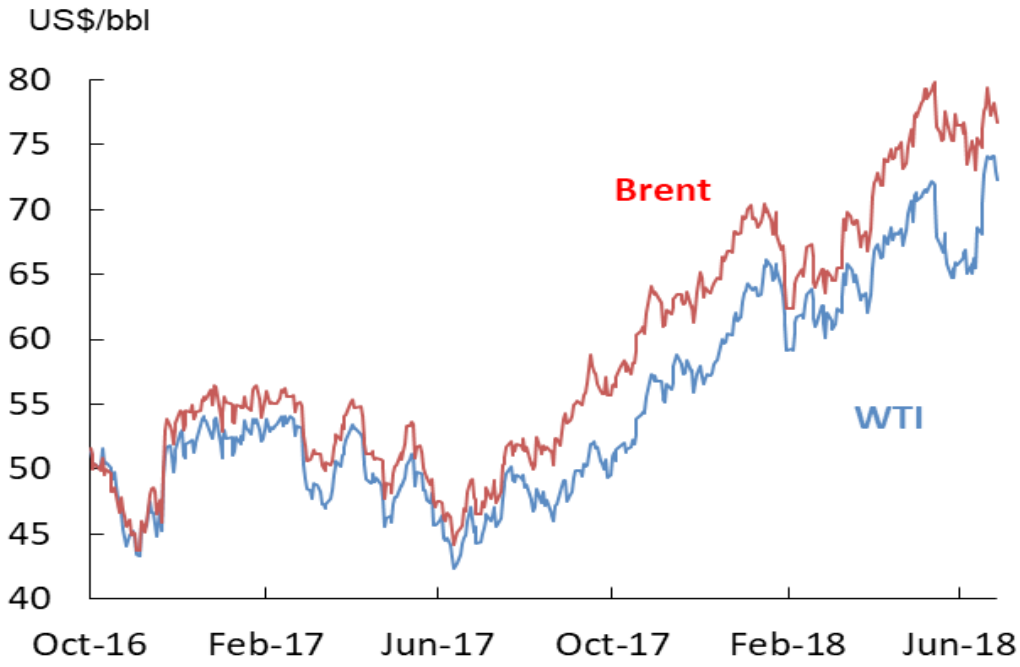
Source: IEA, World Bank, shaped area represents IEA projection

It was clear from the outset that the successful implementation of the production cuts would raise prices and help the OPEC+ countries replenish their budgets with extra revenues. But it might also give U.S. shale producers (which have contributed the most to oil production gains in the past few years) an opportunity to renew price hedges that would prolong the oversupply crisis rather than solve it. The actual developments indeed proved that U.S. shale was technologically suited to respond to higher price by raising output and could perform the part of the balancer in the market, at least to some extent. The problem with U.S. shale producers, however, is that there are dozens of independent oil companies that do not act in concert but rather as independent actors guided by Adam Smith's "invisible hand". The adjustment, therefore, might either not happen in time or come along as a classical overproduction crisis pattern. Hence, replacing the "call on OPEC" with a call on U.S. shale is likely to require passing through a prolonged period of a low oil price and excess volatility that will see significant collateral damage, i.e. postponed and canceled investments into the next generation of projects around the world that will then cause problems and possible price spikes in a few years' time. Then, in a mirror image of today's situation, we might have a consistent deficit on the global market and a significant oil price spike leading to a new, different type of crisis. This is the key reason for OPEC+ to find a way of managing the oil market in which the share of oil production with higher reactivity to price signals is now much greater than before.

Thus, in addition to reaching the immediate goal of market rebalancing OPEC was contemplating over a larger consideration. It was to ensure long-term marketability of oil against the competitive market pressures of non-carbon sources of energy. This meant that pushing the oil price too high in the search for the market equilibrium may result in the emergence of disruptive technologies that could undermine long term demand for hydrocarbons. OPEC was keen not to repeat the mistakes of the previous decade when it had allowed oil prices to get out of control and opened a Pandora's Box of sluggish demand and new sources of supply.

The price recovery in 2017 was sustained by favorable market conditions in the form of a robust surge in global oil demand amid a relatively moderate expansion of U.S. shale supply. Global oil demand is expanding at its fastest pace in five years, thanks mostly to the United States' rekindled love affair with gasoline and robust demand in China and India. By the end of 2017 a barrel of Brent bounced back to $70, and during the first quarter of 2018 it fluctuated between $60 and $70. In May Brent almost touched $80 per barrel. The OPEC+ deal has been extended, first till March 2018, and then till June 2018 with some indications that OPEC+ is going to restrict the supply for many years ahead, if necessary. After some delay U.S. crude oil output started to respond to the price incentives and broke the record 10 mmbpd level in November 2017. It is now set to grow strongly as long as prices remain north of $70.

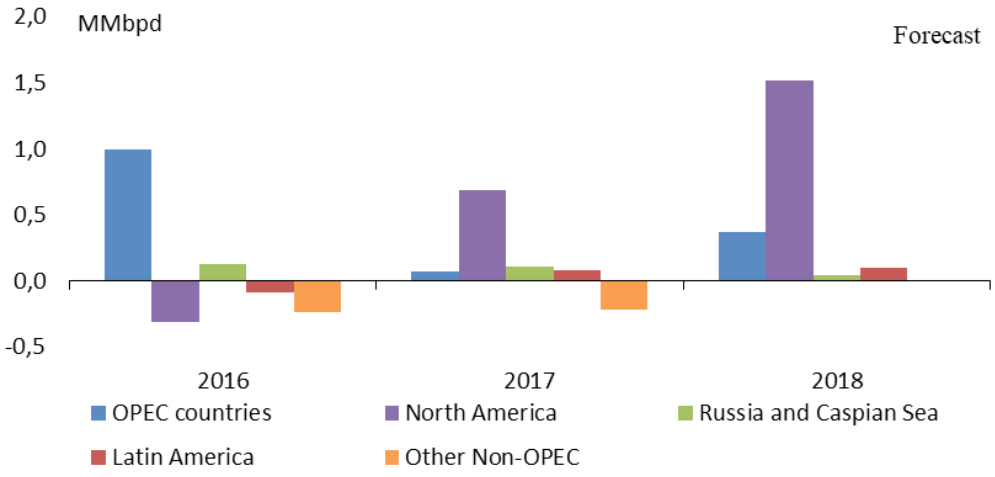
Figure 9: Crude Oil Prices



Source: Bloomberg

Moreover, in addition to crude oil production gains, the United States is going to deliver robust growth in natural gas liquids. Combined crude oil and liquids increment in the United States in 2018 is going to amount to 1.3 mmbpd, according to IEA.

Figure 10: World crude oil and liquid fuel production growth



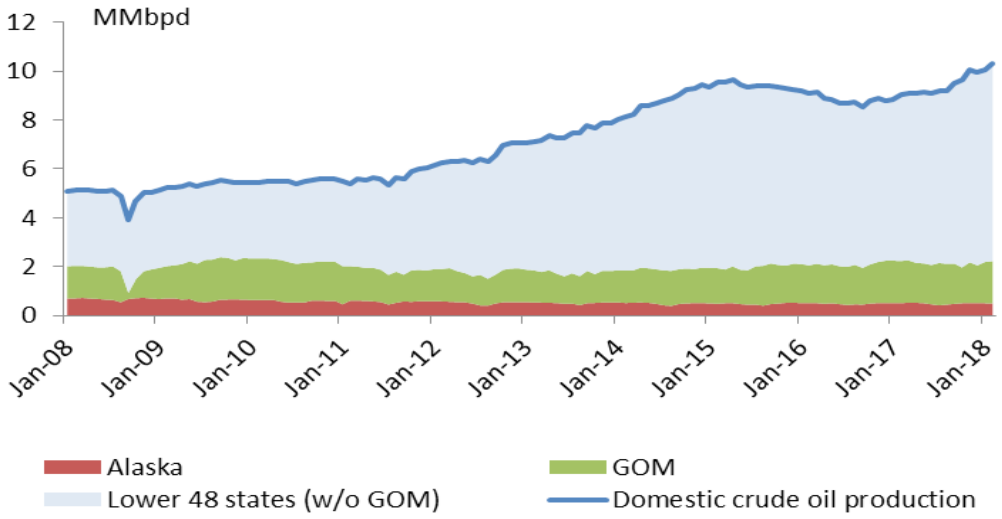
Source: EIA STEO, December 2017

But higher oil prices pose risks for demand, both in near term as price elastic consumption is lower than expected and, more importantly, in longer term as substitution effects take place and alternative forms of energy replace oil in the energy balance. This calls for an uneasy task of defining a sustainable oil price range that is going to provide a balanced solution for producing and consuming nations. (Fattouh & Economou, OPEC at the Crossroads, 2018)

Shale Revolution in the United States: The Continuing Miracle in the Oil Fields

The oil boom in the United States rolls on. In November 2017 U.S. crude oil production passed the 10 mmbpd mark and is well on target to exceed 11 mmbpd in 2018. Since the beginning of 2009, when the U.S. oil industry started its current production drive, U.S. crude output has increased by over 92 percent, and the incremental addition amounted to 4.7 mmbpd. In fact, the United States managed to turn the clock 50 years back and achieve the levels of production last seen in 1970 (Figure 11).

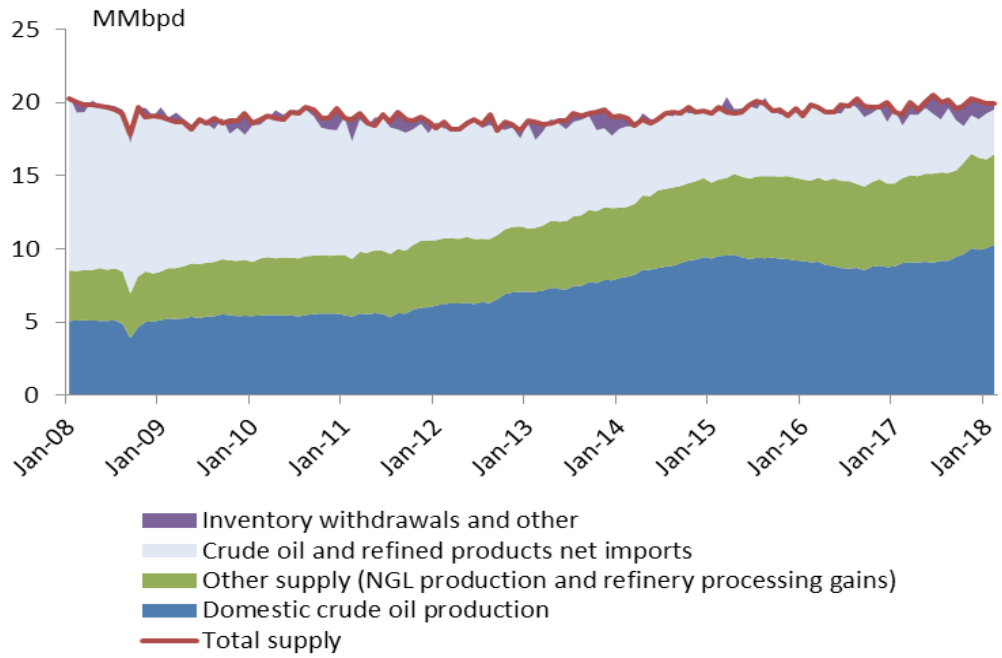
Figure 11: U.S. domestic crude oil production



Source: CEPR NRU HSE, data EIA

But it is not about crude oil alone. Within the composition of U.S. petroleum supply the share of natural gas liquids (NGLs), byproducts of the booming shale gas output plays the ever larger role (Figure 12).

Figure 12: Composition of U.S. petroleum supply

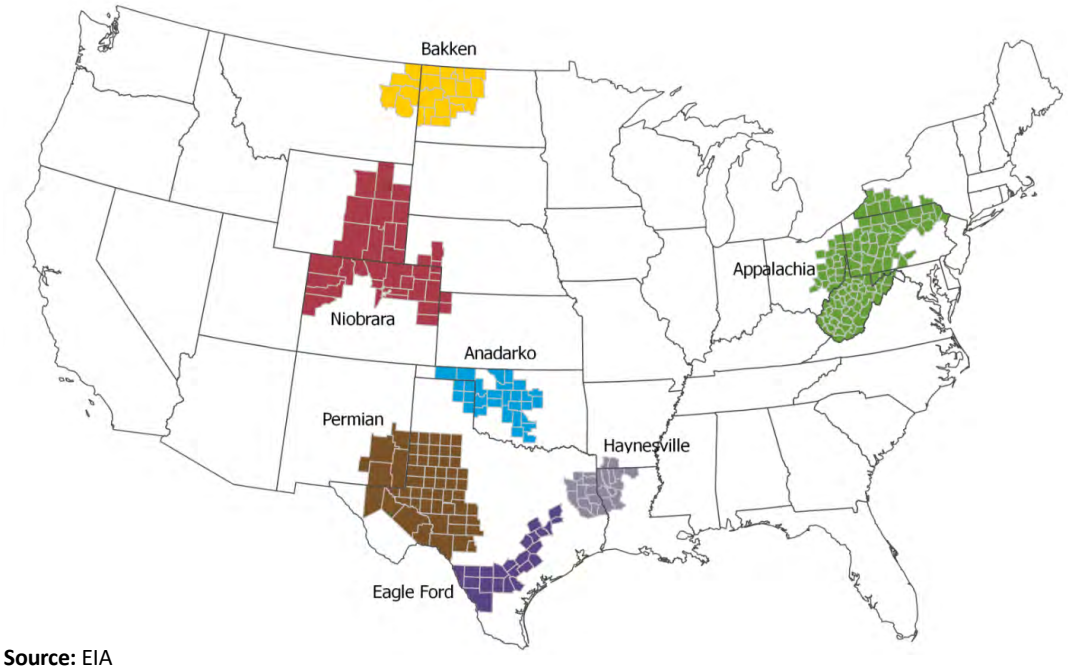


Source: CEPR NRU HSE, data EIA

A renaissance of oil production in lower 48 states, which had been widely written off as a growth prospect, has far-reaching consequences for U.S. energy security and global oil trade flows. One of the most remarkable changes is reduced dependence on imports of petroleum. From 2009 to 2017 U.S. crude oil imports declined 24 percent, from 9 to 6.8 mmbpd. At the same time, The United States has become a refined product net exporter. Combined net imports of crude and products went down 61 percent, from 9.7 to 3.7 mmbpd.

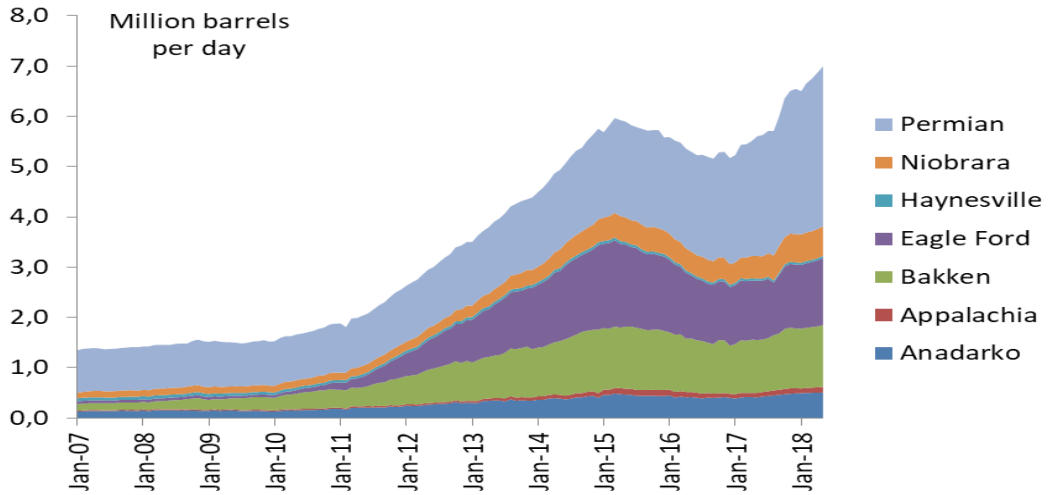
How is the United States doing it? Ten years ago, when the U.S. tight oil phenomenon began unfolding, the implications of the new technology were mere speculations. Now, a decade on, the results that are emerging are a surprise on a historic scale with respect to gains in productivity and cost reductions. Tight oil production growth is based on three pillars: intense drilling activity necessary to offset high decline rates of unconventional developments, hydraulic fracturing, and horizontal drilling. New drilling onshore can respond to price signals relatively quickly. High elasticity of U.S. oil supply has been based on the reactivity of a well-developed service sector, large park of drilling rigs inherited from the boom in shale gas, and favorable geology.

Figure 13: Oil producing regions in the United States



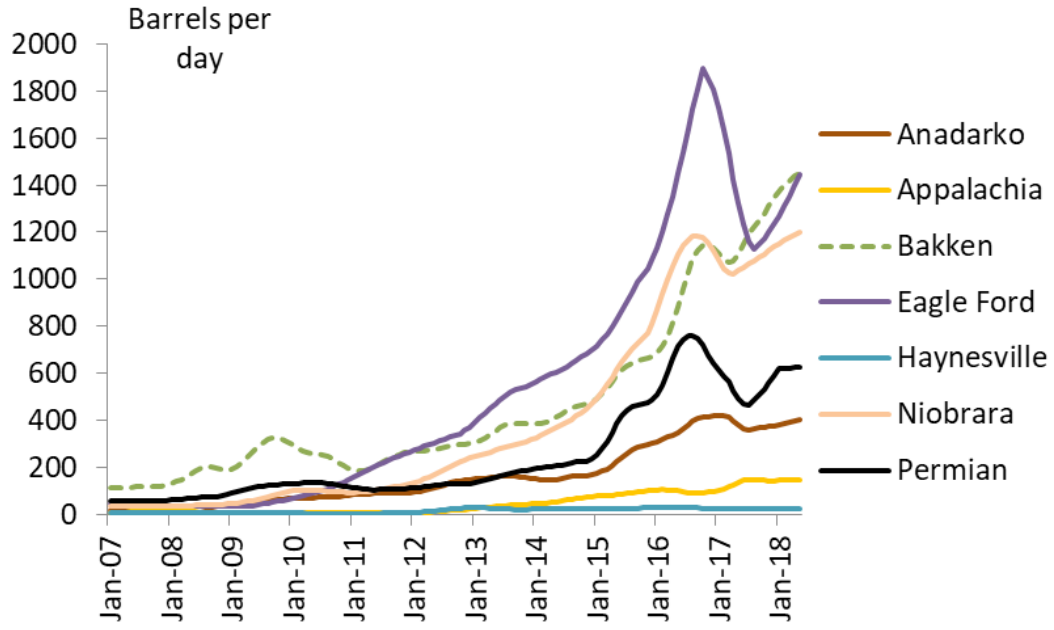
Source: EIA

Figure 14: Oil production in the continental United States by region



Source: CERP NRU HSE, data from EIA

Figure 15: Oil production per rig by US producing region



Source: CEPR NRU HSE, data from EIA

During 2014-2018, we have become witnesses to a live experiment on a grand scale. The U.S. tight oil production has lived through a period of extreme price volatility. As expected, U.S. oil producers attempted to become new balancers for the global market. They expanded their output during the high phase of the price cycle and scaled it back during the price downturn. They have demonstrated resilience to price declines and ability to bounce back following price recovery. The productivity gains made by the U.S. oil industry have been spectacular. Some commentators suggested that shale revolution in the U.S. is overturning the old order. (Fensom, 2016).

At the same time, lively debates have been going on regarding the nature and sustainability of the gains achieved by U.S. tight oil producers. There are two sides to this discussion. One argues that innovation and technological progress have been the most important determinants of the shale revolution. The proponents of these views point out that digitalization in the oil fields, better subsurface modeling, and new efficient drilling techniques have been the structural elements that brought down the costs of tight oil recovery. These gains, according to the "structuralists", are permanent and lay the foundation for "lower for longer" oil price environment. The other group of researchers has been focusing on the "cyclical" elements of the U.S. tight oil developments, such as high grading, effects of price hedging, and spare capacity within the value chain. These researchers stressed that the observed productivity gains and low costs may be temporary and short-lived if the cyclical market forces reverse themselves as the industry changes gears and instead of arresting the decline has to ensure robust growth. (Difiglio, 2014) In this scenario the continuation of growth of U.S. tight oil output would require much higher breakeven prices than those observed in 2016 at the lowest point in the cycle. Breakeven costs serve as integral characteristics of the interplay of many factors that affect field development and combine both structural and cyclical elements of the equation. The timing of the assessment of costs, however, matters a great deal, because of the mismatch between price and cost drivers.

An important paper by Kleinberg et al gives a balanced view as it discusses various aspects of tight oil production in the United States linking it with analysis of breakeven costs. (Kleinberg, Paltsev, Ebinger, Hobbs, & Boersma, 2016). Three arguments by Kleinberg et all deserve particular notice. First, the authors note that oversimplification of technological "reactivity" of tight oil production led many analysts to believe that the United States can take over OPEC's role in balancing global oil supply as tight oil developments in the United States can be very responsive to changes in markets. (Dale, The New Economics of Oil, 2015) This certainly seemed true from 2009 to 2014, when tight oil production grew from 0.7 mbd to 4.2 mbd. However, these dramatic growth rates do not imply tight oil is cheaper or easier to produce than conventional oil. "In fact, tight oil wells, requiring horizontal drilling and massive hydraulic fracturing, are more expensive and more complex to construct than most conventional oil wells, requiring specialized capital equipment, such as bottom hole assemblies capable of directional drilling and fleets of truck-mounted high-pressure high-volume pumps" – write Kleinberg et al.

The so-called "Red Queen Race" phenomenon that is often used to characterize the tight oil production (the necessity

to continue new drilling to avoid rapid production declines) is key to understanding individual well performance, but not oil fields. "Unlike conventional reservoirs, which are defined by well-defined traps, "shales" are continuous, i.e. they were formed as the result of sedimentary processes that occurred in bays or shallow seas of substantial extent. Nonetheless, although these sedimentary basins may be hundreds of kilometers in extent, the richest zones, and the zones most susceptible to hydraulic fracturing, can be quite localized. Thus, there are considerable variations in breakeven points between and within sub-plays" - note Kleinberg et al. The expansion of drilling programs into new areas in the United States prevented sharp production declines even in the face of changing economics of production.

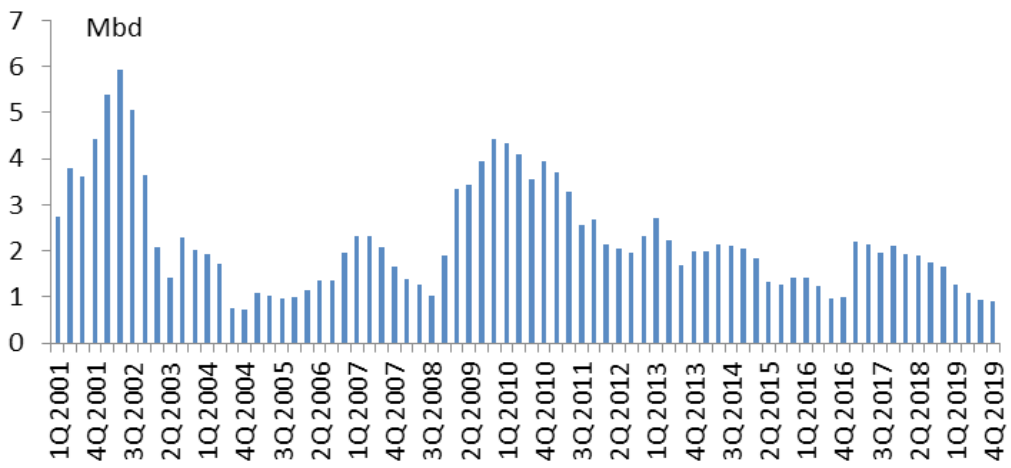
Secondly, one of the pitfalls of inadequate understanding of breakeven points is failure to realize that they change with time, note Kleinberg et al.:

> "Changes can be gradual, reflecting steady improvements in infrastructure and efficiency (endogenous changes). They can also be remarkably sudden, as oil and gas producers, and the organizations that service them, respond to changing economic conditions (exogenous changes). Breakeven points change exogenously as a result of changes in the price of oil … During a period of sharp declines in oil price, endogenous and exogenous factors combine to reduce the breakeven point of tight oil. Just as importantly, the relevant type of breakeven point changes with time. During periods of industry expansion, when producers move into new plays, the full cycle breakeven is relevant to planners and investors. In stable markets, when activity is focused on in-fill drilling and modest step outs in de-risked plays where infrastructure is in place, half cycle breakeven economics is most relevant. When markets are in free fall and oil companies are focused on survival, the profitability of existing assets is measured against lifting costs".

The tiered nature of breakeven points is important, stress Kleinberg et al, because the tiers are relatively far apart. The researchers estimate that in mid-2014, full cycle breakeven points for U.S. tight oil produced by massive hydraulic fracturing was generally in the range of $60-$90/bbl. However, half cycle breakevens were in the range of $50-$70/bbl, and lifting costs were below $15/bbl. "When oil prices declined, not only did these brackets move to lower cost ranges due to endogenous and exogenous drivers, but there was a large-scale transition from greenfield full cycle projects, to the half cycle economics of drilling to maintain level production, and eventually, after the second half of 2015, to production from existing wells".

Thirdly, there are factors that contribute to inelasticity of U.S. tight oil production. These factors increase resilience of tight oil production to price declines, but also limit the potential swing on the upside, or rather require very high oil price environment for the realization of full potential of tight oil. Therefore, there are serious limitations to the idea that the United States can replace Saudi Arabia as the world's swing producer. Spare productive capacity remains the key to performing the balancing of the oil market on the global scale. Spare capacity is defined as production that can be brought on stream within 30 days and sustained for at least 90 days. (US EIA) Saudi Arabia, the largest oil producer within OPEC and the world's largest oil exporter, historically has had the greatest spare capacity. Saudi Arabia has usually kept more than 1.5 - 2 million barrels per day of spare capacity on hand for market management. Currently, however, OPEC spare capacity is at relatively low levels which are projected to decline even further in 2019 (Figure 16).

Figure 16: OPEC spare productive capacity



Source: US EIA

While the state-owned Saudi Aramco can increase production rapidly, the U.S. tight oil industry cannot. In addition, unlike OPEC members, who can increase or reduce their oil production in concert, the hundreds of U.S. producers cannot and will not coordinate their activities. Financial and labor markets also introduce inelasticity. The ready availability of capital played an important role in the growth of the U.S. tight oil industry, with many producers, year after year, operating at negative free cash flow (cash flow after capital investments). As projected by WoodMac, five top U.S. shale producers can achieve positive cash flow by 2020 if prices are on average above $50 per barrel. However, this vision of surging cash flow could prove a mirage if investors continue to focus on production rather than profitability and margins. "By prioritizing production growth over profitability and margins, investors and producers are at risk of killing their goose before it lays a golden egg." (World Oil, 2017) The future availability of debt and equity financing is potentially a limiting factor for the swing producer function, especially in an environment of rising interest rates. A second limiting factor is labor availability. Labor required in the tight oil sector, along with associated equipment, made a smooth transition from gas drilling to oil drilling in 2009. Following massive layoffs from the petroleum industry in 2015 and 2016, skilled labor may not be as abundant in the future as it has been in recent years or may not be available at the same cost. Thus, the estimates of breakeven cost range for the United States in a rapidly evolving industry such as tight oil production, becomes uncertain. Inelasticity in the response of oil production to market signals is a further complication, the understanding of which requires close examination of individual well decline curves and their implications at play level, oilfield and takeaway infrastructure, capital markets, and labor factors, conclude Kleinberg et al.

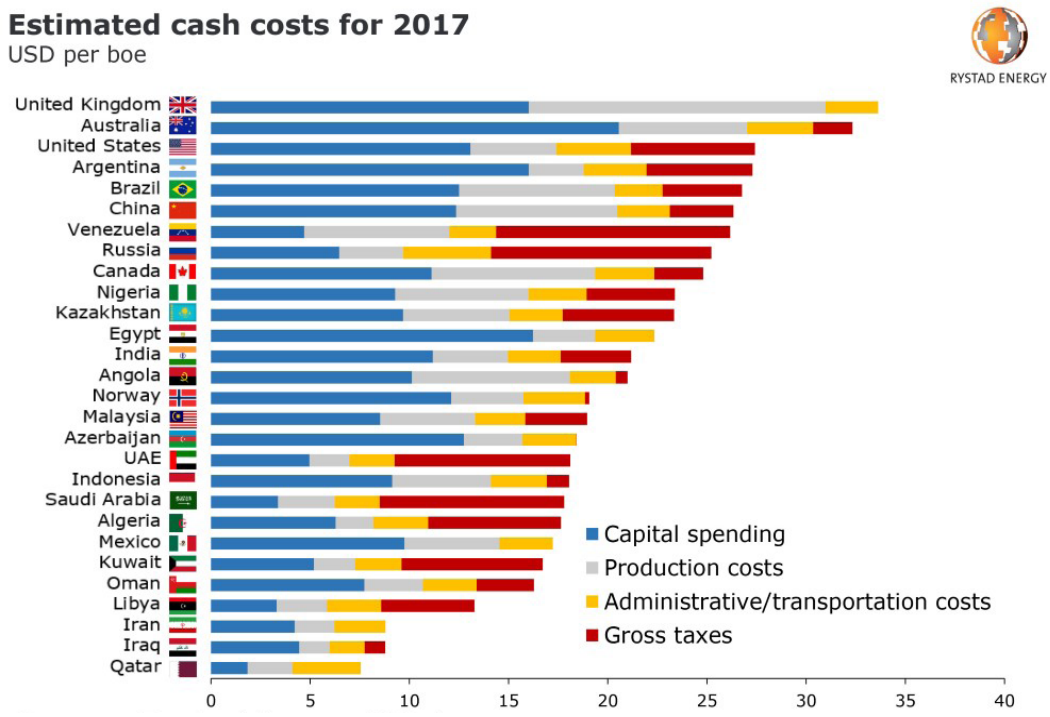
The live experiment continues. At the time of this writing the U.S. oil production is approaching the new record of 11 mbd. The price of WTI exceeded $70 per barrel. The developments of U.S. tight oil in 2018 so for suggest that the industry can continue delivering production growth, but it comes with a cost – significantly higher breakeven prices required by the U.S. oil producers.

Saudi Arabia: Reinventing Its Role as Market Balancer

For many years Saudi Arabia was the key driving force within OPEC and indispensable swing supplier and global oil market manager. This position was based on abundant low cost production base and readily available spare productive capacity. The shift in Saudi Arabia's policy in November 2014 raised questions about its future role in the oil markets. Is Saudi Arabia still relevant in a world where U.S. tight oil output could seemingly quickly respond to changes in demand and prices? As argued in (Fattouh & Sen, Saudi Arabia Oil Policy: More than Meets the Eye?, 2015) "Given Saudi Arabia's multiple objectives and its limited number of policy tools, the kingdom always faces a trade-off when it comes to its oil output policy. Shaped by changing market conditions, lack of internal cohesion within OPEC, non-cooperation from non-OPEC producers, and the advent of U.S. shale, which introduced many uncertainties with respect to the supply response, the trade-off for Saudi Arabia in the current market context has favored market share over short-term oil revenue maximization". But "while Saudi Arabia faces the revenue maximization–market share trade-off in the short term, its oil policy is also shaped by long-term considerations such as its investment in the oil sector and the availability of spare capacity, diversification of its economic base, and climate change and energy security policies that affect the long-term demand for Saudi oil and the share of oil in the global energy mix". The key competitive advantage for Saudi Arabia has always been its low costs. In terms of cash costs (as estimated by Rystad Energy) which matter most at times of price wars, the kingdom is well positioned to beat any possible competition.

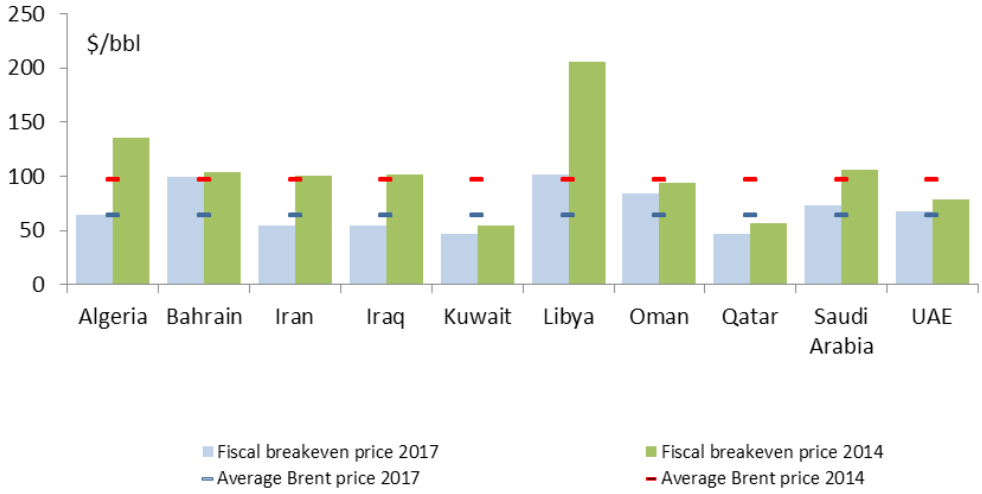
However, high reliance on oil revenues, and the difficulty of diversifying the economy away from oil mean that the so-called fiscal breakeven costs matter a great deal for Saudi Arabia. During the period of $100 oil and the Arab Spring uprisings most of oil exporters in the Middle East, including Saudi Arabia expanded their social spending exposing their budgets to high fiscal breakeven prices (prices of oil at which budget deficit is zero). According to IMF estimates, fiscal breakeven price for Saudi Arabia in 2014 was $106/bbl. (IMF, 2017). Some analysts misused the fiscal breakeven price analysis putting too much emphasis on these numbers as "thresholds" that associate with greater risk for the countries involved rather than just one piece of a broader stability assessment. (Clayton & Levi, 2015) The truth is that many oil exporters have a variety of economic tools that could be used to adjust to a prolonged low-oil price scenario. Oil-exporting countries' fiscal obligations can and do change in the face of the adverse circumstances (Figure 18).

Figure 17: Ability to Compete in a Price War



Source: Rystad Energy UCube

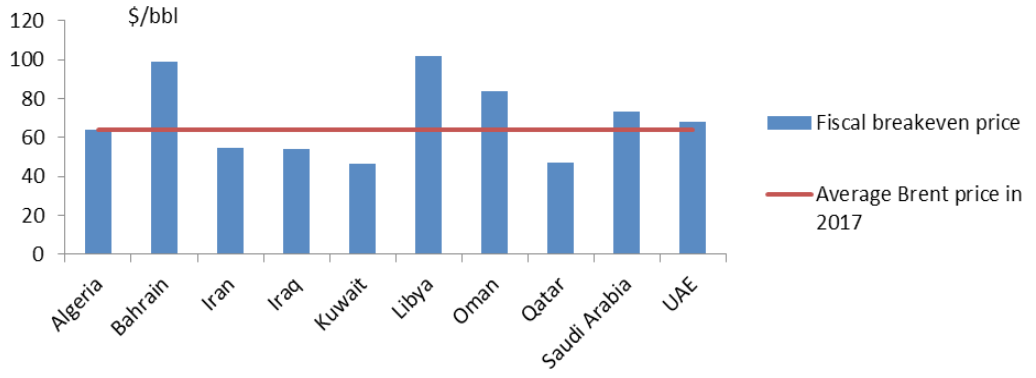
Figure 18: Oil Price Declines Caused Budget Optimization in MENA Countries



Source: CEPR NRU HSE, IMF data

But even with tough measures taken by Saudi Arabia on cutting multiple subsidies in 2015-2017 and higher oil price in 2017, the fiscal breakeven price for the Kingdom was still higher than market price.

Figure 19: Higher oil price in 2017 helps most MENA exporters balance budgets

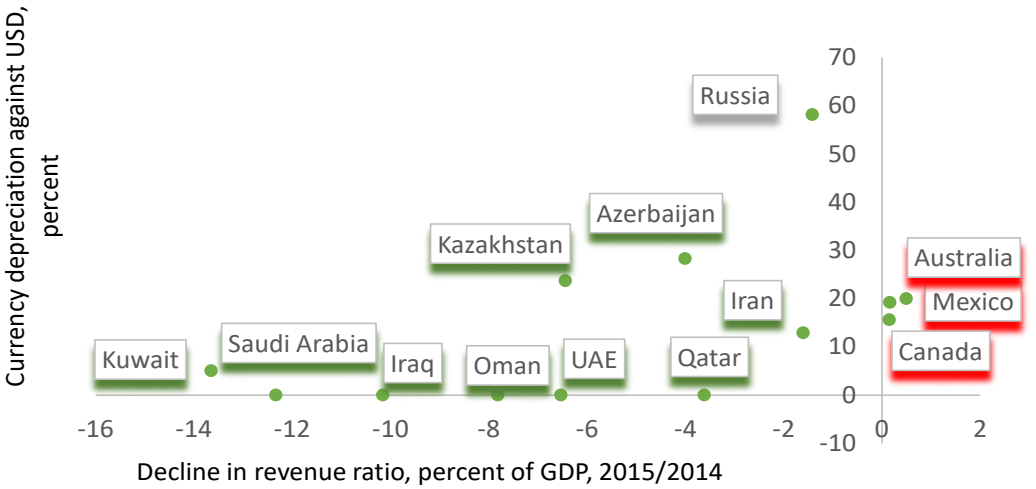


Source: CEPR NRU HSE, IMF data

One of the problems that Saudi Arabia is facing is its inability to depreciate its currency to soften the negative impact of the low oil price environment. Saudi economy is so much dependent on oil, foreign imports of consumer goods and so little diversified that floating exchange rate is hardly an option. But the fixed exchange rate means that during price shock the only way to balance budget is to draw upon currency reserves. To be sure, during the "fat years" Saudi Arabia managed to accumulate a formidable "war chest" of foreign currency reserves.

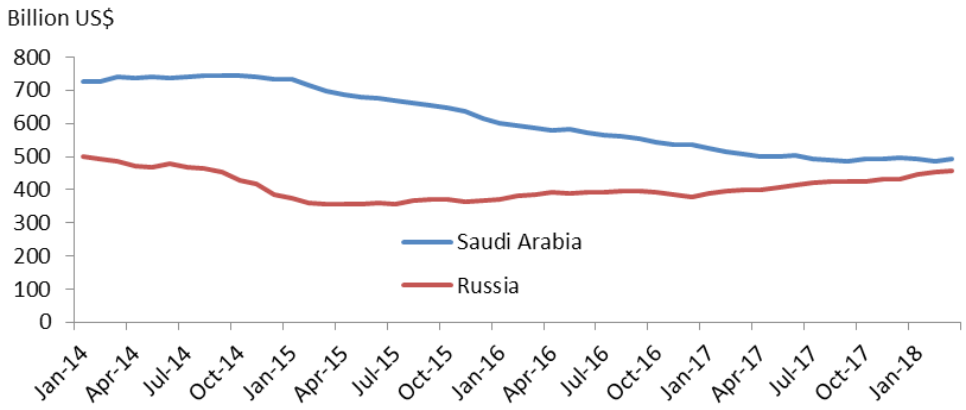
In this respect it is important to compare Saudi Arabia's decline in budget ratio and the dynamics of its currency reserves with other major oil exporting countries that allowed their currencies to depreciate during the price slump. Russia provides the most striking comparison as in 2014-2015 it went for the most radical currency depreciations among the peer group (Figure 20). This kind of a "shock therapy" allowed Russia to quickly stabilize its foreign currency reserves. In contrast, Saudi Arabia had to finance its budget deficit via constant draws from its reserves. The speed of the depletion of the "safety cushion" for Saudi Arabia started causing concerns, especially during 2015-2016. It is also worth noting that in the middle of 2015 Saudi's currency reserves exceeded Russia's by over 300 billion U.S. dollars, but by the middle of 2017 the difference shrunk to mere 30 billion U.S. dollars (Figure 21).

Figure 20: Currency depreciation helps avoid budgetart revenue declines



Source: CEPR NRU HSE, data IMF and Russia's Ministry of Finance

Figure 21: International Currency Reserves: Saudi Arabia vs. Russia



Source: CEPR NRU HSE, data from IMF

Protracted period of low oil prices, therefore, is a double-edged sword for the Kingdom. While low prices induce a rebound in global demand and drive out non-OPEC supply, they also put pressure on state revenues. Given the limited effectiveness of their legacy policies in the future in which energy demand is going to shift towards renewables, Saudi policymakers recognize that diversifying their economies and income sources should be a top priority.

It is in this context that in late April 2016, the Council of Ministers in Saudi Arabia approved an ambitious new strategy for the kingdom, known as Vision 2030. (Saudi Arabia, 2016) Among three main pillars of the Vision, which are intended to help transform the Saudi economy and society by 2030 are the central role that Saudi Arabia plays in the Islamic and the Arab world, potential to become a global investment powerhouse, and potential to become a global trade hub connecting the three continents of Asia, Europe and Africa. The Vision 2030 aim at three broad strategic goals for the Kingdom: to develop a vibrant society, build a thriving economy, and grow an ambitious nation. A key goal of the thriving economy theme is to build a well-diversified economy, which is less dependent on oil revenues.

The events of 2015-2016, such as the replacement of Oil Minister Ali Al-Naimi by Khalid Al-Falih, the creation of the enlarged Ministry of Energy, Industry and Mineral Resources, the announcement of the Saudi Aramco Strategic Transformation program, and plans to publicly list a minority stake in Saudi Aramco were taken as clear signs of a drastic shift in energy policy. There has been a lot of discussion among analysts whether Saudi Arabia may abandon its policy of maintaining spare capacity and could boost output, with the effect of putting a cap on oil prices in the near-term or that it may expand its oil production capacity, which is bearish in the long-term, especially because this may be taken as a signal that the kingdom is moving beyond oil and rushing to monetize its reserves in a carbon-constrained world. (Fattouh & Sen, Saudi Arabia's Vision 2030, Oil Policy and the Evolution of the Energy Sector , 2016)

As argued by Fattouh and Sen, the replacement of Ali Al-Naimi as oil minister "represents a change of personnel but not of policy". Saudi Arabia oil policy is flexible and could change depending on a change in other producers' behavior and/or changes in oil market conditions. "The Saudi energy sector", write Fattouh and Sen, - "remains key to a smooth transition to the vibrant economy envisioned and will continue to play a vital role in the country's future. Furthermore, the overall direction of Saudi oil policy in terms of its production and investment policy, maintaining spare capacity, integrating down the value chain through investing in refining and petrochemicals, increasing the role of gas in the energy mix, introducing efficiency measures and deploying renewables in the power mix to free crude oil for exports are not likely to change in the next few years".

Russia: Braving the Perfect Storm

The prolonged slump in global oil prices in 2015-2016 hit Russia hard and has led to a sharp reversal of circumstances for the economy. Russia's economy is diversified and more or less self-sufficient which prolongs resilience to crisis, but the costs of withstanding the "perfect storm" of the combined effects of economic recession, international sanctions and low oil

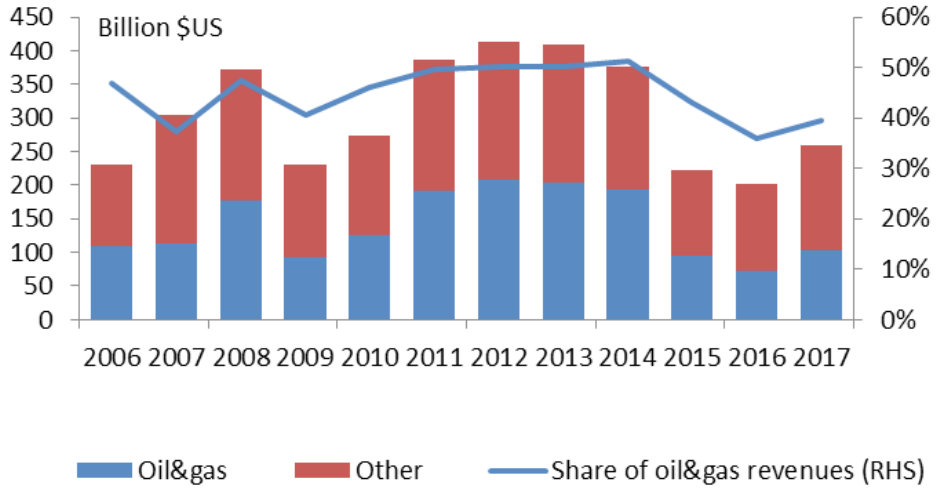
prices had been extremely high in 2015-2017.

The stress test of low oil prices in export markets has had the most significant impact on state revenues from exports of Russian oil. It has reduced the safety cushion of low cost legacy production and sunk infrastructural costs in Russia's oil industry. But even if Russia may never be as strong as it looks, it is also never as weak as it looks – and the country has proven this formula throughout its difficult history.Russia's overall anti-crisis policies in 2015-2017 followed the path of state dirigisme tested during the previous oil price slump in 2009 with some elements of neo-liberal macroeconomic policies especially with regards to exchange rate policies and efforts to control inflation. But the implementation of this strategy proved much more difficult than in 2009 owing to the duration of the low phase in the oil price cycle and the overall negative international environment. Russia's default policy responses focused on managing the budget deficit via sharp depreciation of the ruble, but these policies alone fell short of addressing the complexity of the present crisis. After falling 3.7 percent in 2015 Russia's GDP has remained in the negative territory in 2016 as well, declining 0.2 percent. A return to positive growth of 1.5 percent occurred in 2017, but the big worry for the near future is the low percentage growth for Russia as compared to the average world economic growth and to the rates of growth among the advanced world economies and peer emerging market and developing economies. This means that absent another spike in the global commodity prices during the next few years Russia will be falling behind its key international competitors in economic development and its share of the world GDP will be shrinking.

At the outset of the oil price slump in the end of 2014-beginning of 2015 most Russian top energy decision-makers along with majority of experts and market watchers thought of an oil crisis as a relatively short-term development, similar to the crisis of 2008-2009. On November 28, 2014 Russia's President Vladimir Putin met with France's Total CEO Patrick Pouyanne and said: "Winter is coming and I am sure that the market will come into balance again in the first quarter or towards the middle of next year". (Kremlin, 2014) In February 2015 Igor Sechin, CEO of Russia's largest oil company Rosneft called the 2014 oil crisis "just a ripple on the water compared to the oversupply tsunami of 1985" and warned that "excessive reduction of investment in production now could lead to a shortage of oil already in the fourth quarter of the current year". (Rosneft, 2015) It is not surprising, therefore, that the Russian default policy responses in early 2015 in anticipation of a relatively short-term crisis followed the recipes that had proved their success during the previous stress test for the Russian economy, obviously with some modifications as a result of the lessons learned and also with the introduction of new policy elements designed to address new challenges, technology transfer problems in particular. In very broad terms, the key goals of Russia's present anti-crisis strategy have been as follows:

- Counter-cyclical investments across the energy value chain, while seeking to diversify the Russian economy away from dependence on hydrocarbons over the long term;
- Macroeconomic stabilization by means of depreciation of the currency to keep state budget in balance, preserve Russia's foreign exchange reserves, avoid capital flight and help exporters remain competitive;
- Import substitution policies to deal with the constraints introduced by the international sanctions.

Figure 22: Russia's Federal Budget Revenues



Source: CEPR NRU HSE, data from Russia's Ministry of Finance

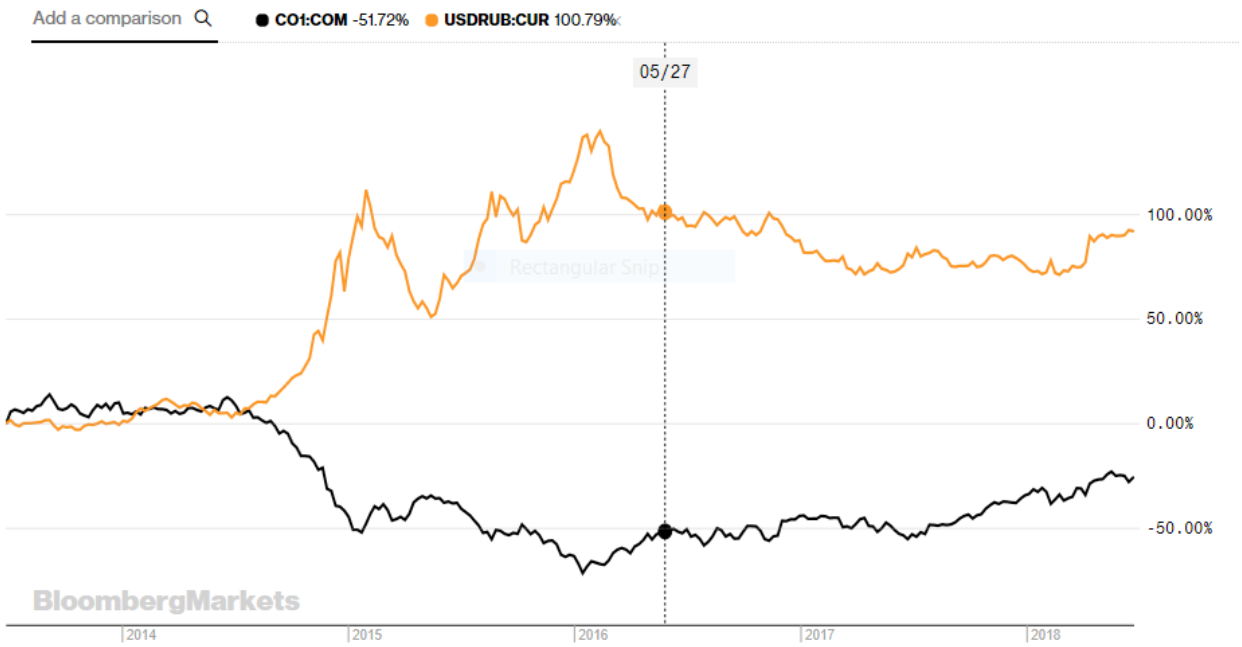
But the implementation of this strategy is proving much more difficult now than in 2009. First of all, the 2009 economic recession in Russia and the resulting stress-test for the energy sector projects were severe, but relatively short-lived when compared to the present situation. Oil price remained under $60/bbl for only about six months, from December 2008 to May 2009. Then it bounced back to over $100/bbl in February 2011 and stayed above $100 until September 2014 giving the Russian economy a much needed booster shot. As a result, Russia escaped this crisis relatively unscathed. But at present, oil price has been under $60 (on average) for more than three years and the shrinking revenues from the sales of hydrocarbons along with the pressure from international sanctions have been putting Russia to a much tougher test (Figure 22). The new financial constraints make trade-offs between the key anti-crisis strategy goals inevitable. Consequently, Russia's energy sector will be greatly constrained to meet some of its ambitious targets, let alone all of them simultaneously.

Two key elements in Russia's macroeconomic policy response to the crisis to date have been:

- The new Central Bank of Russia's (CBR) flexible exchange rate policy;
- Managed federal budget fiscal deficit.

The present Russia's anti-crisis policy stands in sharp contrast with the 2008-2009 recession when the CBR attempted for some time to protect the ruble by selling U.S. dollars only to watch its hard currency reserves shrink by staggering $100 billion in November-December 2008 alone and only then moved to the "managed depreciation" policy. This time the CBR started using the floating exchange rate mechanism from the very start of the recession in late 2014 and refrained from major interventions on the currency market to protect the ruble. This has prevented massive flight from rubles into U.S. dollars as the exchange rate spiked and it became prohibitively expensive to speculate against the ruble. In the beginning of 2016 the Russian currency depreciated further on the back of new lows in oil prices but has recovered recently along with the rebounding oil prices during March-June 2016. During 2018 the Russian government started deliberately using the policy of weak currency. In spite of oil price recovery to $70 per barrel and above, the ruble did not strengthen owing to Russia's policy of putting any extra revenues from oil prices above $40 per barrel into the rainy day fund.

Figure 23: Oil Price and Russian Ruble



Source:Bloomberg

This latest policy allows the Russian government to comfortably balance its budget. For a given combination of oil price and exchange rate there is a "comfort zone" for Russia's policy makers (Figure 24). In fact, during 2018, on the back of higher oil prices, Russia achieved federal budget surplus.

Figure 24: Russia's budget deficit: Sensitivity to oil price and exchange rate

RUBLE TO US$ EXCHANGE RATE	OIL PRICE, US$/BBL								
	70	65	60	55	50	45	40	35	30
60	-0.6	-1.3	-2	-2.8	-3.6	-4.4	-5.3	-6.3	-7.3
65	0	-0.6	-1.4	-2.2	-3	-3.9	-4.8	-5.8	-6.8
70		0	-0.8	-1.5	-2.4	-3.3	-4.2	-5.3	-6.4
76			0	-0.9	-2.7	-2.6	-3.6	-4.7	-5.8
84				0	-0.9	-1.8	-2.9	-4	-5.2
94					0	-0.9	-2	-3.1	-4.4
105						0	-1.1	-2.3	-3.6
120							0	-1.2	-2.6
140								0	-1.4
168									0

PARAMETERS THAT KEEP RUSSIA'S BUDGET DEFICIT WITHIN 3% TARGET

As a result of the new CBR floating exchange rate approach Russia's hard currency savings for the rainy day consolidated in the national stabilization funds have been shielded from the pressures of protecting the ruble and could be used instead to finance the budgetary deficit. But Russia still remains an economy heavily dependent on revenues from hydrocarbons sales. Oil and gas accounted for over 50 percent of Russia's federal budget revenues in 2014. In 2016 amid the low price environment for oil and gas this dependency was greatly reduced, to only 36 percent, but bounced back to 40 percent in 2017 as prices rebounded. It is inevitable that this ratio strengthens further in 2018.

Another negative factor for Russia's economy and its oil sector has been the regime of international sanctions. Two obvious effects of the sanctions have been:

- Increased costs of borrowing for Russia as a result of restrictions on long-term financing for the affected entities expanding beyond their original scope.
- Damage to Russia's long-term technological development via restrictions on equipment supplies and technology transfer, in the area of unconventional, deep-water and shelf oil developments in particular.

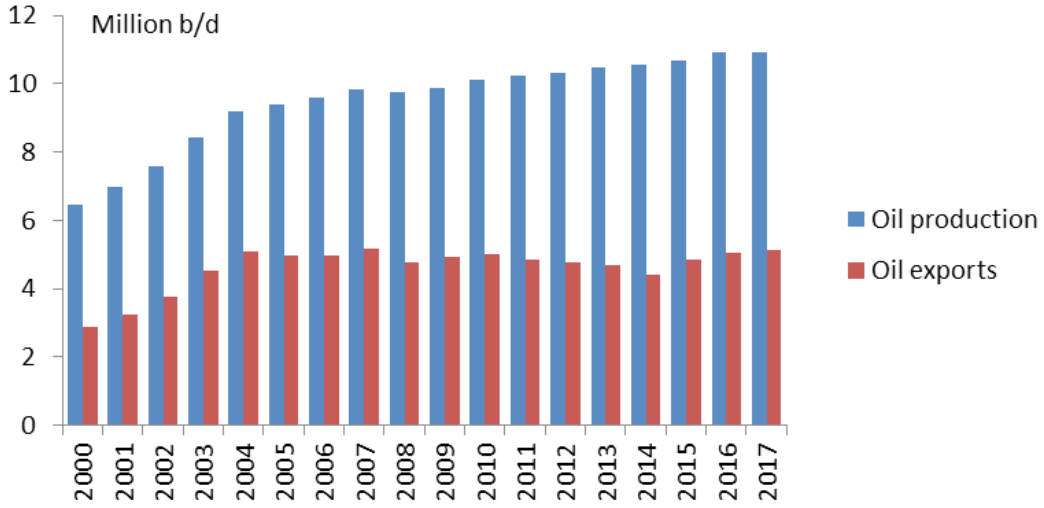
The first effect became apparent almost immediately after the sanctions were introduced as the flow of foreign finance to the Russian companies practically stopped. In addition to the sanctions, the world's major rating agencies have lowered their Russian ratings thus making international credit less affordable for all Russian entities. This forced deleverage has affected Russian oil and gas companies in particular. The financial sanctions affecting the Russian oil and gas industry most directly restrict international lending for several leading energy companies: Gazprom Neft (GPN), Rosneft, and Transneft are subject to both the U.S. and EU sanctions. NOVATEK is on the U.S. sanctions list, but not on the EU list. Both U.S. and EU financial sector sanctions also target various state-owned Russian banks that have been providing loans to Russian oil and gas companies, and also to selected Russian military-industrial companies that have formed some joint ventures in the energy industry.

The Russian oil and gas companies, owing to their significant financing needs and the ability to use their hard currency earnings from exports to ease access to international capital had been the largest Russian corporate users of foreign loans. The sanctions regime made them adjust their model of financing and turn to domestic borrowing instead which was available but at significantly higher interest rates. According to some estimates Russian borrowers had to pay up to 12-13 percent interest on new loans compared with 4-5 percent previously. (Mitrova, 2016) Higher costs of borrowing and the resulting constraints on the resources available for investments have led to reconsiderations of the longer term investment programs

and their optimization. But in the short term, the capex programs in the oil sector have been largely unchanged (in ruble terms). According to the official Russian statistics, Russian oil companies managed to maintain the levels of their capital investments in 2015, bringing them to 1.1 trillion rubles (up 9.6 percent year-on-year). The dollar value of this capex went down almost by half, but most of the short term investment was ruble denominated. (Russia's Ministry of Fuel and Energy, 2016)

Prior to the crisis many analysts considered Russia to be a high cost producer that needs $100 oil to keep its oil production from falling. These analysts were wrong. Not only Russia showed resilience to low oil prices and remained number one crude oil producer in the world in 2017, it managed to deliver robust oil production and exports increases since 2000 (Figure 25).

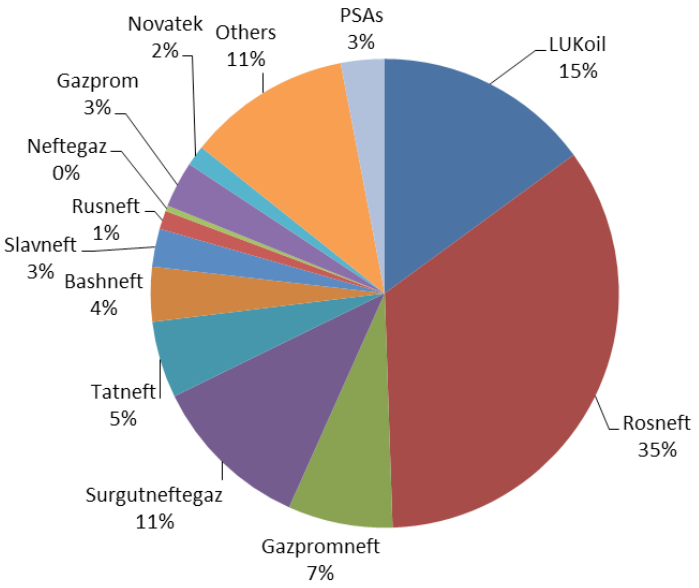
Figure 25: Russia's Oil Production and Exports



Source: CEPR NRU HSE, Russia's Ministry of Energy data

Figure 26 highlights high concentration of production among five key players that account for over 75 per cent of total Russian oil production (if their share in joint ventures is included), with Rosneft alone producing 35 percent. The Russian state directly controls about half of Russia's oil production via its ownership interests in Rosneft, Bashneft, Gazprom and Gazpromneft.

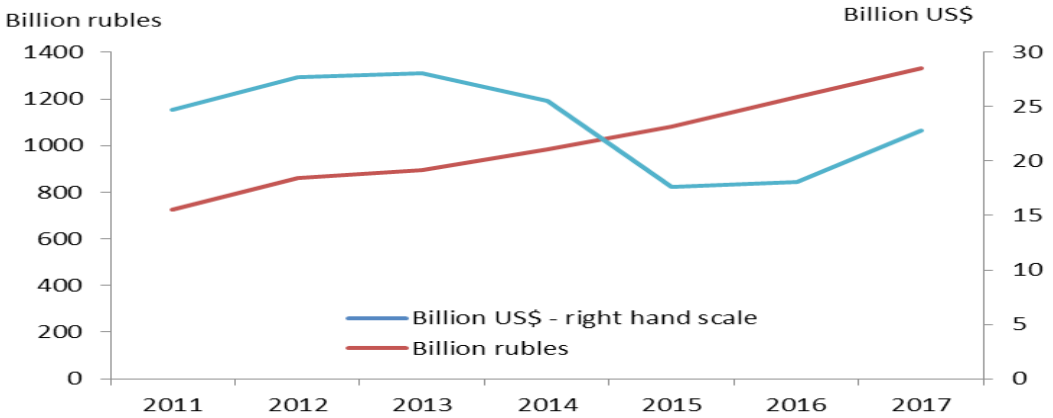
Figure 26: Russia's Oil Production by Company in 2017



Source: CDU TEK

The OPEC+ deal put breaks on Russia's oil production growth, but according to Russian oil companies statements they are ready to ramp up their volumes. Russian oil companies invested through the cycle and benefitted from the ruble depreciation, because about 80 percent of their costs are denominated in rubles.

Figure 27: Russia's oil production capex

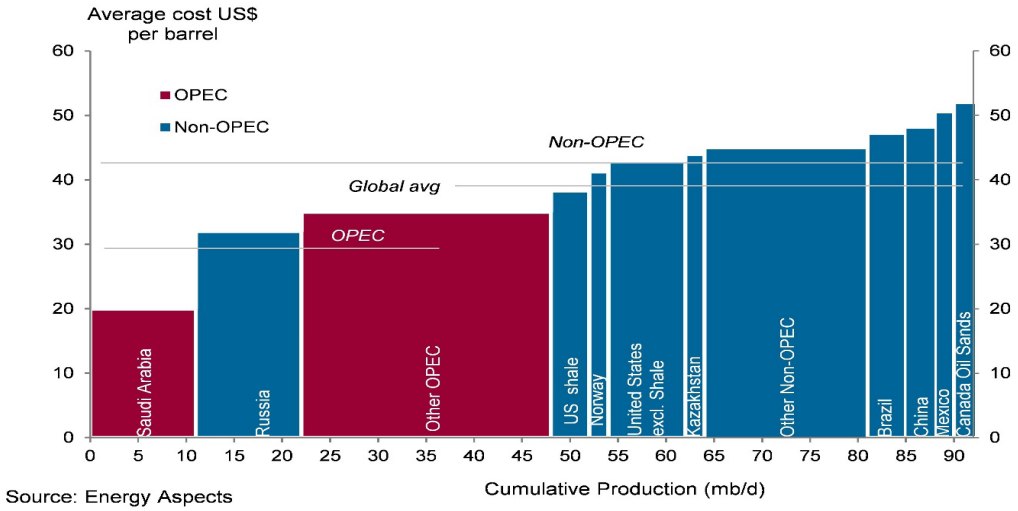


Source: CDU TEK

Three key drivers of Russia's oil resilience to low oil price environment have been as follows:

- **Flexible tax take that varies with oil price.** Russia's mineral extraction tax and export duty both are the sliding scale levies that are directly linked to the price of Urals crude. The combined marginal rate of these two key taxes used to be almost 90 percent. It has been reduced recently, but the overall arrangement is for the state to take the lion's share of oil price increase through taxes. In effect, Russian oil companies never always lived in $50 minus oil environment in terms of their netbacks. All the upside from $100 oil had been taken by the state via taxes. But it also means that when oil prices decline, the state takes the entire blow, while the oil companies maintain their profitability.
- **Ruble depreciation lowered ruble-denominated costs.** As already mentioned earlier in the paper, Russia experienced one of the most extreme currency depreciations among oil exporting countries. Weak ruble is very beneficial for oil exporters with revenues in dollars and costs in local currency. The ruble costs of oil extraction and transportation represent significant share of overall costs for Russian oil producers.
- **Russia's oil production base is concentrated in brownfield assets.** Most of oil produced in Russia still comes from brownfield operations. Going forward, the share of hard-to-extract oil is going to grow, with obvious cost pressures, but the lifting costs in Western Siberia, especially post-depreciation, can rival those of oil producers in the Middle East (Figure 28).

Figure 28: Global cost curve



Source: Energy Aspects

Can this change in the future? A comprehensive paper by Henderson reviews different issues related to Russia's oil production outlook. (Henderson, Key Determinants for the Future of Russian Oil Production and Exports , 2015) Henderson notes that managing the decline in Russia's brownfields will be vital for the industry, as they account for around 85 percent of Russia's overall production. In the past usage of Western technology and Western financing helped keep the decline rates under control, but the key question going forward is how Russia will go alone. Russia's transition strategy has been focused on providing tax incentives to oil producers via a variety of instruments that would ensure that total production does not decline. "The consistent growth of production since 2000 suggests that the Russian government does have a fairly successful history of making ad hoc adjustments to the tax regime to encourage the maintenance of crude output", – notes Henderson.

The Russian government is currently considering a significant shift in tax strategy, which first, would transfer tax burden from upstream to downstream via the reform of export duty regime, and second, would introduce elements of profit-based taxation in Russia's production taxes that for many years had been revenue-based. These measures will provide greater incentives to invest in new greenfield projects, as well as more expensive enhanced recovery techniques at brownfield sites.

Conclusion

The Big Three global oil producers – the United States, Saudi Arabia, and Russia – will continue to play decisive role in charting the path for the world that is transitioning towards the non-carbon future. This transition can be evolutionary but can also lead to dramatic and disruptive price volatility. The markets have not been able to prevent oil crises in the past, and new crises await us in the future. Saudi Arabia and Russia are trying to establish a framework that would last beyond the market rebalancing, setting a mechanism for the long term oil market management. The challenge is how to find compromise for many producing and exporting countries with different revenue needs and different degree of financial resilience. The role of the United States is in finding the balance between the rush to produce and achieving profitability for its tight oil developments. Now that most of U.S. tight oil producers have secured their position on the global supply curve, it is time to return to profitability in operations. This is likely to require oil price to be in the $60 to $80 per barrel corridor.

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