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DISCUSSION PAPER
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The Challenge of Managing Boom and Bust Oil Prices in the Global Oil Market

Robert McNally

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Glossary

API	American Petroleum Institute (when referencing API oftentimes meant represent API Gravity, a measure of a crude oil's density.
EIA	Energy Information Administration
EV	Electric Vehicles
GDP	Gross Domestic Product
IEA	International Energy Agency
mb/d	Million Barrels per Day
OPEC	Organization of Petroleum Exporting Countries
OPEC+	Organization of Petroleum Exporting Countries and a selection of other oil-producing countries such as Russia that have agreed to coordinate production with OPEC
SUV	Sport Utility Vehicles
TRC	Texas Railroad Commission
US	United States
WTI	West Texas Intermediate

The Challenge of Managing Boom and Bust Oil Prices in the Global Oil Market

by Robert McNally
President, Rapidan Energy Group

The lifeblood of modern civilization

Since Edward Drake drilled the first commercial well in Titusville, Pennsylvania in 1859, oil has transformed the global economy, predominantly via its use as a transportation fuel. Oil will remain the primary fuel for powering the movement of people and goods on the ground, in the air, and at sea for the foreseeable future. Along with its other crucial uses, including heating, power generation, and as a feedstock for petrochemicals, it has become nothing less than the lifeblood of modern civilization. Nevertheless, oil's impacts on foreign affairs and the environment continue to pose increasingly important questions and uncertainties for producers and consumers.

The two largest uncertainties confronting oil are: (1) a new era of price volatility that stems from the lack of a swing producer who can help manage supply and demand imbalances; and (2) growing societal and political pressure to sharply reduce oil use in the coming decades to address global warming.

Globally traded and priced

Crude oil and petroleum products are broadly fungible, among the most heavily traded international goods, and are priced globally.

Oil is usually traded via long-term and spot contracts, with individual grades priced at a discount or premium to regional benchmarks - Brent crude in Europe, West Texas Intermediate (WTI) in the US, and Dubai for cargoes to Asia. Generally, heavy and sour crudes (crudes with a low API and high sulfur content, such as Venezuelan crudes) are priced at a discount to the benchmarks, while those that are light and sweet (crudes with a high API and low sulfur content, such as US shale) are priced at a premium. These relationships tend to remain relatively stable, meaning that global crude prices generally move together.

Given crude's fungibility and interconnected regional benchmarks, a significant supply disruption in one location or region raises prices and revenues for producers everywhere, just as weak demand caused by an economic slowdown would lower prices and revenues for all producers. Because oil is globally priced, Guyana's oil revenue will depend not just on local supply and demand, but on the interplay of global oil market fundamentals, geopolitical trends and events, and energy policies.

Oil prices and revenues are prone to wild "boom and bust" swings

It is crucial to understand why oil prices are prone to extremely large boom and bust cycles in the absence of a swing producer.

Oil production and consumption exhibit very high short-term insensitivity or "inelasticity" to price changes. On the demand side, transportation (by far the largest driver of oil demand) is essential for consumers to get to work, buy food, and deliver goods and services. There are no large-scale substitutes for oil in transportation in the short term. As such, oil consumption does not change significantly with price changes over the short run.

Economists estimate oil's short-term price elasticity of demand to be around -0.06. This implies that an event that removed 6% of global oil supply would cause oil prices to double in order to eliminate the resulting demand surplus and rebalance the market.

Oil supply is also inelastic or unresponsive to short-term price changes. As Guyana is now well aware, finding and developing an oil field takes many years, with high up-front, sunk capital costs. But once oil flows, operating costs are relatively low. Thus, producers have an incentive to fully utilize production capacity in all but the worst price environments in order to earn a return on large upfront investments.

Because production and consumption are so insensitive to price changes, large price swings are required to force producers and consumers to change their behavior. This dynamic makes oil prone to boom/bust price cycles. Storage can help alleviate price booms and busts on the margin by supplying the market in a deficit or soaking up excess crude in a surplus, but it is neither costless nor infinite.

The quest for price stability

From the beginning of the modern oil industry to today, boom-bust price cycles have bedeviled oil drillers and governments alike - the latter due to oil's emergence as a critical transportation fuel. Excessive gyrations in oil prices destabilize investment planning and contribute to economic uncertainty. They can spawn domestic unrest and geopolitical instability, threaten economic growth, and make monetary policy harder to manage.

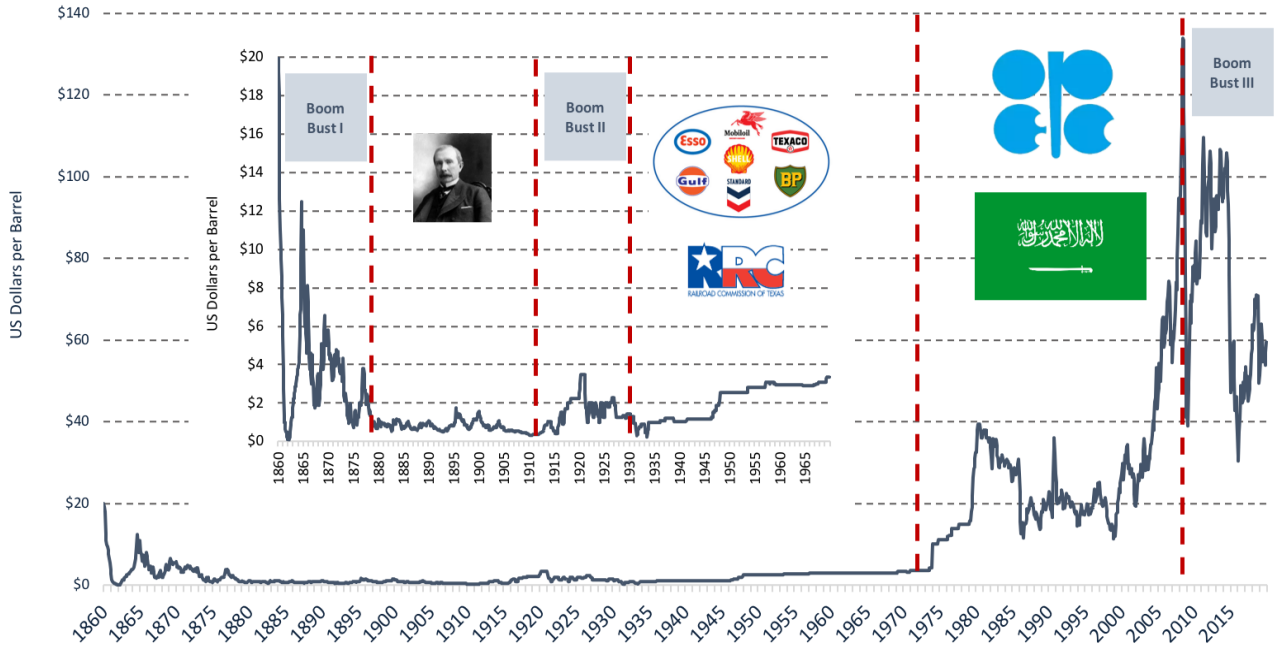
History has shown that the only true prescription for limiting oil's volatile price cycle is through a "swing producer" who is able and willing to adjust production quickly and, if necessary, for a long period of time to prevent supply-demand imbalances that would otherwise trigger harmful price instability.

When a swing producer holds back supply that it could otherwise produce, the resulting latent production potential is called "spare capacity." Traditionally, spare capacity is defined as upstream production capacity that can be brought online within 30 days and is sustainable for at least 90 days.
Quick production adjustments and spare capacity afforded by swing producers provide the market with something that normally does not exist – flexible supply with near-instantaneous response. Throughout the history of the industry, three swing producers emerged to impose price stability with varying degrees of success. The first, John D. Rockefeller's Standard Oil Company at the turn of the 20th century, imposed price stability indirectly by monopolizing refining and integrating with midstream pipeline and

railroad companies. In later decades, the Texas Railroad Commission (TRC) and Saudi Arabia have led groups that employed upstream supply control and spare capacity retention to directly stabilize crude prices.

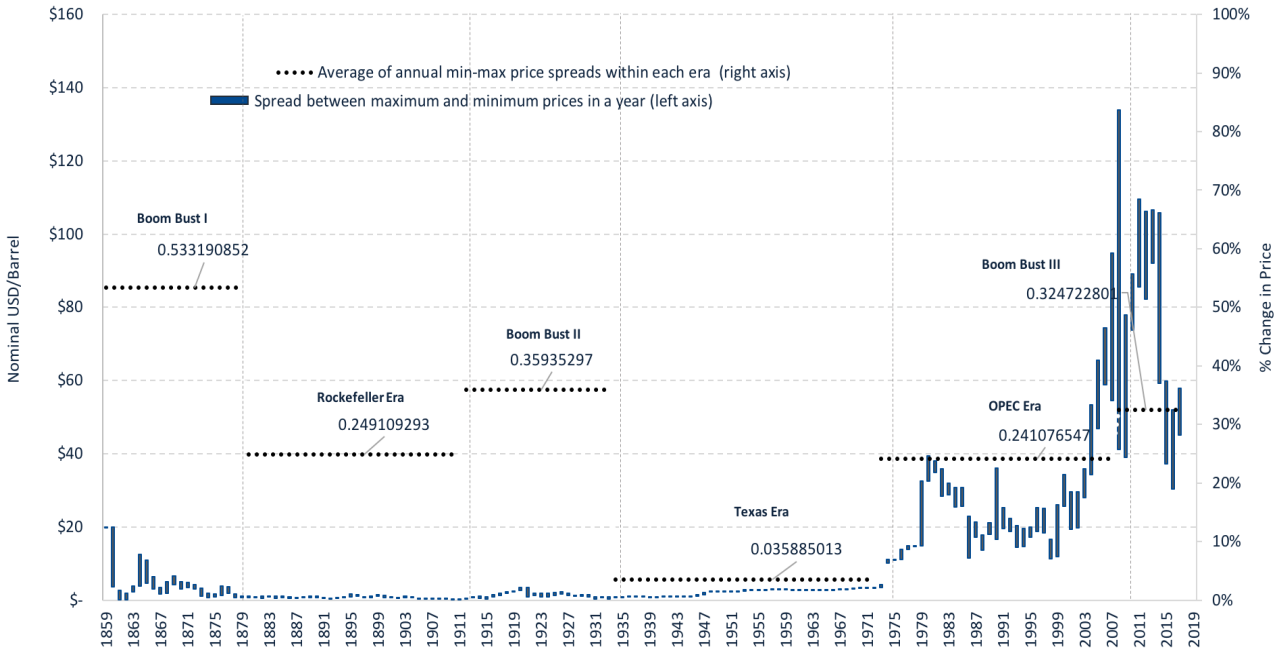
Crude Oil Prices

Nominal, Source: The Derrick, API, St. Louis Fed, EIA, Rapidan Energy Group



Annual Ranges of Monthly US Crude Oil Prices, 1859-2019

Data Sources: Rapidan Energy Group, based on The Derrick, API, St. Louis Fed, EIA, and Bloomberg



From 1932 until about fifteen years ago, either the TRC or OPEC has attempted to stabilize prices. But the recent return of unusually large oil price swings reflects the absence of an effective swing producer. Oil prices nearly quintupled from 2003 to 2008 despite no supply disruption as OPEC ran out of spare capacity in the face of surprisingly strong demand growth and limited non-OPEC supply growth. Oil prices then crashed by 60% between the summer of 2014 and early 2015 after Russia rejected Saudi Arabia's demand to share in the burden of supply cuts to offset strong US shale production and Riyadh refused to cut alone. In 2015 and 2016, many hoped US shale would play the swing producer role and put a floor under oil prices. But US shale is no substitute for spare capacity.

US shale oil will not be the new swing producer

In theory, shale's shorter production cycle - quarters as opposed to the years required for conventional production - lowers supply inelasticity and makes it more responsive to prices. But shale oil has proven ill-suited to the swing production role. While it has shorter cycles than conventional oil production, shale output still does not adjust fast enough to prevent large imbalances. Even if shale companies were able to adjust swiftly enough, US antitrust laws prohibit them from collaborating to do so.

OPEC+ is a more plausible successor to OPEC, but the jury is still out

After shale failed to fill the swing producer role as many had hoped, oil prices crashed to $26 in February 2016. That price bust - a crash of 75% in 18 months - caused Russia, whose leaders harbored painful memories of the 1986 oil price collapse that contributed to the dissolution of the Soviet Union, to relent and agree to cooperate with Saudi Arabia in organizing collective supply cuts. Those cuts were implemented in December of that year. Saudi Arabia and Russia then took the lead in organizing a new, larger group of producers (dubbed "OPEC+") to replace OPEC as the world's oil supply manager and price stabilizer. OPEC+ has had some success at stabilizing prices since 2014. Voluntary production cuts, along with geopolitical disruptions, pipeline outages, and natural disasters, have helped reduce the large inventory builds that emerged in 2015. Earlier this month, OPEC+ agreed to implement further production cuts to combat an oversupply in the first half of next year from causing a renewed price bust.

It is too soon, however, to judge whether OPEC+ will prove to be an effective swing producer in the years ahead. History shows price busts often spawn ad hoc producer cartels that attempt to coordinate supply, but that those cartels often fail once the price emergency passes, discipline erodes, and supply from outside the group rises. However, memories of the recent oil price collapse are still fresh, and one should not underestimate the determination of producers to prevent them from recurring near-term.

Mitigating oil price volatility

While swing production is the most critical factor in stabilizing oil prices, there are other steps that can potentially help limit oil price volatility:

1. *Welcome speculators*. Oftentimes, players in the oil market may use speculators – or market participants that bet on the movement of prices – as scapegoats for

wild price swings. They argue speculators capitalize on price swings, exacerbating the peaks and troughs. On the contrary, speculators help to add liquidity to the market, which producers and consumers need to hedge. Deeper and more-transparent financial markets consisting of speculators and natural hedgers help to stabilize oil prices.

2. *Improve data*. The absence of timely, comprehensive, and credible data increases uncertainty and adds to oil price volatility. Governments must work to ensure production, consumption, and stock data become more accurate and timelier. Better data will allow producers and consumers to foresee major market imbalances and proactively prepare.

3. *Storage capacity and strategic stocks*. Storage capacity helps to smooth price adjustment during imbalances. Though storage is limited, bouts of oil price volatility induce industry to expand inventory capacity. In addition to commercial stocks, large oil-importing countries hold strategic stocks for emergency supply disruptions. The impact of strategic stocks is greater when used collectively.

Peak oil demand

Alongside the critical question concerning the emergence of a new, effective swing producer, the other big uncertainty facing the oil industry is whether government policies aimed at drastically reducing the use of oil in transportation will succeed. Whereas in the past the oil market has periodically worried about peak supply, today's new concern is "peak demand," or the expectation that policy-driven efficiency gains will rapidly reduce the use of oil, especially in transportation.

Oil demand is a function of population, income growth, and efficiency gains. Looking at history and taking these three factors into consideration, global oil demand tends to grow by about half the rate of GDP growth. Thus, if global GDP is expected to average around 3%, oil demand should be expected to rise by about 1.5% annually, or about 1.5 mb/d in today's current 100 mb/d global market.

But looking at just the next decade, leading agency forecasts see global oil demand growing by about 0.7 mb/d annually, or one-half the historical rate[1]. The reason is assumed higher efficiency gains resulting from government policies aimed at limiting oil consumption, subsidizing alternative fuels, improving vehicle efficiency standards, and promoting the rapid proliferation of electric cars.

As discussed below, we are skeptical about the rapid efficiency gains expected by leading forecasters. But if demand does decelerate rapidly, the implications for producers vary depending on their production costs. Producers with relatively high operating costs such as extra-heavy Canadian oil sands or US shale oil companies will likely be hurt and prices fall in response. On the other hand, lower-cost producers such as Saudi Arabia will be better able to withstand the low prices.

Today's "peak demand" consensus is premature

While reducing oil consumption to fight climate change enjoys unprecedented political attention and earnest support,

1 In their latest long term forecasts and for the period 2020-2030, EIA expects 0.4 mb/d; OPEC 0.7 and IEA 0.8 mb/d of annual average oil demand.

especially in Europe, Rapidan's policy and fundamental analysis concludes that current government subsidies and mandates will fall short of stated targets and consensus forecasts. President Trump is likely to ease US auto efficiency standards and challenge California's ability to independently impose more stringent standards, and China began cutting EV subsidies this summer, causing sales to collapse. While the public and some investors have enthusiastically backed new EV ventures such as Tesla, their support hasn't translated into sales that meaningfully reduce the dominance of gasoline-powered cars in the world's vehicle fleet. EVs remain beyond the financial reach of most consumers, who in recent years have been shifting their preferences to less fuel-efficient SUVs and trucks.

Expect an oil price boom to follow bust

We are skeptical that the high efficiency gains assumed by leading forecasters will materialize in the coming decade. Whereas IEA forecasts assume efficiency gains of 2.3%, we assume 1.5%. IEA's forecast is both higher than the recent average and contrary to the three year trend, which shows efficiency gains slowing rather than accelerating. Global energy efficiency growth slowed for a third consecutive year in 2018, with the rate of improvement falling from 1.7% in 2017 to 1.2%. IEA attributed the slowdown to increased industrial production, long-term structural factors (e.g. more building floor area per person), and weak investment and policy stimulus.

Our models indicate that should peak demand policies prove less impactful than consensus expects, oil demand could grow by about 1.5% in the next ten years, twice as much as consensus-leading public agencies expect. Meanwhile, US shale oil growth is likely to slow appreciably due to capital constraints and possibly hostile public policy after the 2020 election. If we are correct about a delayed energy transition and slowing shale, the oil market is likely to structurally tighten over the coming years and in the next decade. In the last structurally tightening market between 2003 and mid-2008, oil prices nearly quintupled due to the inelastic demand and supply factors mentioned above. In this scenario, today's consensus that oil assets are "stranded assets" would be replaced with concern over inadequate resources.

About the Author

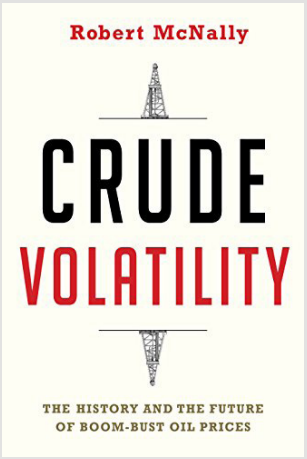
Robert McNally is the founder and President of Rapidan Energy Group, an independent energy consulting and market advisory firm based in the Washington DC area. He has over 29 years of government and market experience as an international energy consultant, senior White House policy official, and hedge fund strategist. His expertise spans government, economic, security, and environmental sectors. He is the author of the acclaimed and award-winning book Crude Volatility: The History and the Future of Boom-Bust Oil Prices (Columbia University Press, 2017).

Robert has testified before Congress on energy markets and national security, published on energy in Foreign Affairs (co-authored with Michael Levi), and has been interviewed by CNN, The Economist, NPR, Financial Times, Washington Post, New York Times, PBS' Great Decisions In Foreign Policy series, Bloomberg News, and other leading journals and programs. He is a Member of the National Petroleum Council and is a non-resident fellow at the Columbia University Center on Global Energy Policy. From 2001 to 2003, he served as the top international and domestic energy advisor on the White House staff, holding the posts of Special Assistant to the President on the National Economic Council and, in 2003, Senior Director for International Energy on the National Security Council. He started his professional career as an oil market analyst and for 12 years analyzed energy markets, macroeconomic policy, and geopolitics for portfolio managers at Tudor Investment Corporation. Robert earned his B.A./B.S. in Political Science and International Relations from American University and his M.A. in International Economics and Foreign Policy from Johns Hopkins School of Advanced International Studies (SAIS).

About Rapidan Energy Group

Rapidan Energy Group is a Washington-based energy market, policy, and geopolitical consultancy. Rapidan's team of former senior officials and analysts has extensive, top-level experience spanning financial markets, energy policy and regulation, and foreign affairs and intelligence. Rapidan provides leading global corporations, investors, government agencies and traders with expert, differentiated and actionable insights on energy markets, policy and geopolitics.

Robert McNally
Founder/President
Rapidan Energy Group



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